BIOLOGICAL INVENTORY AND EVALUATION OF MONO CLIFFS PROVINCIAL PARK

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BIOLOGICAL INVENTORY AND EVALUATION OF MONO CLIFFS PROVINCIAL PARK, DUFFERIN COUNTY

K.M. Lindsay

1991

ONTARIO MINISTRY OF NATURAL RESOURCES
CENTRAL REGION, AURORA

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ABSTRACT

Mono Cliffs Provincial Park is a 732 ha Natural Environment park in Dufferin County, just north of Mono Centre. The exposure of the Niagara Escarpment and two dolostone outliers within the park is one of its outstanding geological, biological and scenic features. The Niagara Escarpment received international recognition in February 1990 when it was designated by UNESCO (United Nations Educational, Scientific and Cultural Organization) as a World Biosphere Reserve. The park contains the only major exposure of the Niagara Escarpment along its central section, between Credit Forks and Lavender Falls.

A large (299 ha), continuous area has remained in natural vegetation at Mono Cliffs because of the configuration of the escarpment and the outliers. The large, forested block surrounding McCarston's Lake and its headwater wetlands, on the steeply rolling moraine lands west of the escarpment, is linked to the Niagara Escarpment by a forested re-entrant valley. The forests and wetlands along Sheldon Creek below the escarpment are connected by streams, wetlands and forests to this large natural area. This biological inventory and recent scientific studies at Mono Cliffs confirm the provincial significance of this large continuous natural area and substantiate its highly significant natural and scientific values. It is proposed for protection as a Nature Reserve Zone within the park.

At Mono Cliffs, a wide range of escarpment habitats and distinctive vegetation communities are associated with the thinly-soiled, bedrock pavement rim at the cliff-edge, the high and low cliffs and cliff-face fissure systems, the talus slopes and steep bedrock-controlled slopes. These habitats provide specialized niches for an escarpment-related flora, rich in ferns and fern allies. Among the 44 species of ferns and fern allies known from the park are species such as, Walking Fern (*Camptosorus rhizophyllous*), Smooth Cliff-brake (*Pellaea glabella*), Green Spleenwort (*Asplenium viride*) and Hart's-tongue Fern (*Phyllitis scolopendrium*), which are restricted to limestone rock habitats in the park, along the Niagara Escarpment and elsewhere in Southern Ontario.

The White Cedar forests growing on cliff-faces and cliff-edges at Mono Cliffs and along the length of the Niagara Escarpment, are some of the oldest, most intact, old growth forests in eastern North America. At a small sample site within the park, Larson found trees greater than 300 years in age and one tree of 428 years (Larson 1989, 1990, pers. comm.). The forests of Butternut, Basswood and Yellow Birch found on some of the park's steep talus slopes are notable, as this forest type is known elsewhere along the Niagara Escarpment only from Rattlesnake Point and Mount Nemo (Varga pers. comm.).

The flora of the park is diverse, with 470 species of vascular plants recorded. Of the 26 plant species considered to be significant, three are nationally and provincially rare, Rugulose Grape Fern (*Botrychium rugulosum*), Ginseng (*Panax quinquefolius*) and Hart's-tongue Fern (*Phyllitis scolopendrium*). The documented fauna consists of 22 species of mammals, 82 species of birds, of which 52 are considered to breed in the park, 19 species of amphibians and reptiles, four species of fish and 12 species of molluscs. Significant fauna include: Eastern Bluebird, a species considered to be nationally and provincially rare; diploid Jefferson Salamander, at its northernmost known location here; and Brook Trout, which reproduce along sections of Sheldon Creek within the park.

Mono Cliffs is extremely important for scientific research. In recent years, researchers have conducted at least eight studies into different aspects of the park's natural history. Scientific investigations of a deep fissure cave within the park have identified the bones of 12 mammal species, including Pika and Marten (Savage 1990, pers. comm.). These findings are highly significant because Pika and Marten no longer occur in this part of southern Ontario. At present, Pika occur only in western North America, on talus slopes and steep, boulder-covered hillsides. Also of note are the bones of Fowler's Toad (*Bufo woodhousii fowleri*) reported from the cave (Savage pers. comm.). At present Fowler's Toad is restricted in Ontario to sites along the shoreline of Lake Erie, although this species is widespread throughout the eastern United States (Green 1989).

Because of its undisturbed condition and forested watershed, McCarston's Lake has been chosen for paleoecological research. McAndrews (1990, pers. comm.) is reconstructing the history of the vegetation in the area since glaciation from pollen analysis of the lake sediments underlying McCarston's Lake. Analysis of the top

8.9 m of lake sediments, the last 9,290 years, shows there to have been forests surrounding the lake of similar composition (Sugar Maple, Beech, Elm, Birch, Ash) over the last 7,600 years.

Some very positive changes have occurred to the natural features of Mono Cliffs Provincial Park, since its acquisition in the 1960s. Its forests have matured, many fields have developed diverse, successional communities which complement these forests, and the removal of grazing from forests and talus slopes has probably increased the frequency of fern and moss communities. At the same time, the park has become very well known to naturalists, scientists, educators and the general public. The park receives a high level of day use, an estimated annual visitation of 30,000. Many areas of the park are showing the effects of a high level of recreational use, particularly certain sensitive and highly significant escarpment communities (rim, cliff, cliff-face fissure systems and talus slopes) and certain sections of the official trail system. The proliferation of unofficial trails in the park is also of great concern.

The recommendations in this report focus on: the protection of significant life science features through park zoning and classification, and management planning; the protection of areas with extreme environmental constraints; measures to allow the regeneration of areas damaged by high levels of recreational use; and special management areas requiring restorative management.

PREFACE

Mono Cliffs Provincial Park is one of 116 proposed and existing parks forming the Niagara Escarpment Parks System (Niagara Escarpment Commission 1979). Land for the park was acquired in the 1960s because of its provincially significant biological and geological features, as well as its spectacular scenery.

This biological inventory has been prepared as background information for a Management Plan for Mono Cliffs Provincial Park. Park management plans are revised every ten years by the ministry, and management planning is currently underway. It is one of a series of geological and ecological inventories of provincial parks and other areas of natural and scientific interest. The management recommendations of this study are intended to contribute to the public and agency discussions that will result in a Mono Cliffs Park Management Plan.

Work on this project spanned a two year period, from August 1989 to July 1991. This inventory and evaluation builds on earlier studies by the author (Lindsay 1973, 1976, 1988) and the first ecological assessment of the park (Cuddy 1973). It brings together the natural history observations of other naturalists and scientists who have visited or carried out research studies at Mono Cliffs. The following individuals kindly contributed natural history data on the park: Tom Beechey, Dr. D.M. Britton, Mike Cadman, Mr. W.E. Coleman, Don Cuddy, Ross Evans, Mr. Lloyd Fraser, Joyce and Bruce Hood, James Kamstra, Phil Kor, Jack Imhof, Dr. D.W. Larson, B. Law, Dr. D.H. Lynn, Alex Mills, Dr. J.H. McAndrews, Mike Oldham, John Riley, Chris Risley, Dr. H. Savage, Leo Smith, Steve Varga, Greg Warchol, and John Winters.

This project was supported by the Central Region of the Ontario Ministry of Natural Resources. B. van Staalduinen, H. Pronk and J. Winters administered the project and provided background information on the management of the park. T. Beechey (Parks and Natural Heritage Policy Branch, Ontario Ministry of Natural Resources, Queen's Park) supervised the project and reviewed the draft report in detail. J. Riley shared observations and knowledge of the Mono Cliffs area since 1973 and made editorial suggestions which improved the report. S. Smith drafted the maps and figures and carried out the planimeter calculations.

TABLE OF CONTENTS

Page

ABSTRACT i

PREFACE iii

TABLE OF CONTENTS v

LIST OF FIGURES, TABLES AND MAPS vi

CHAPTER I: REGIONAL BACKGROUND 1

(i) Introduction 1
(ii) Physical and Historical Background 6
(iii) Regional Context of Vegetation 9

CHAPTER II: MONO CLIFFS PROVINCIAL PARK 10

(i) Introduction to Vegetation 10
(ii) Community Descriptions 11

CHAPTER III: PLANNING CONSIDERATIONS 37
(i) Significance of Mono Cliffs Provincial Park 37
(ii) Evaluation of the Proposed Nature Reserve Zone 37
(iii) Significant Areas Within the Proposed Nature Reserve Zone 42
(iv) Other Significant Areas 50
(v) Special Management Areas 50
(vi) Recommendations 52

REFERENCES 59

MAP REFERENCES 66

APPENDIX A: VASCULAR PLANTS OF MONO CLIFFS PROVINCIAL PARK 67

APPENDIX B: BRYOPHYTES OF MONO CLIFFS PROVINCIAL PARK 99

APPENDIX C: MAMMALS OF MONO CLIFFS PROVINCIAL PARK 101

APPENDIX D: BIRDS OF MONO CLIFFS PROVINCIAL PARK 103

APPENDIX E: AMPHIBIANS AND REPTILES OF MONO CLIFFS PROVINCIAL PARK 109

APPENDIX F: FISH AND MOLLUSCS OF MONO CLIFFS PROVINCIAL PARK 113

LIST OF FIGURES, TABLES AND MAPS

Page

FIGURES

1 Location of Mono Cliffs Provincial Park 2
2 Location of Features and Facilities Within and Adjacent to Mono Cliffs Provincial Park 3
3 Vegetation Matrix for Mono Cliffs Provincial Park 14
4 Significant Areas Within the Provincially Significant Nature Reserve Zone Proposed for Mono Cliffs Provincial Park 45
5 Significant Areas and Special Management Areas of Mono Cliffs Provincial Park 51

TABLES

1 Size of Vegetation Communities of Mono Cliffs Provincial Park 12
2 Significant Vascular Plants of Mono Cliffs Provincial Park 40
3 Ferns and Fern Allies of Mono Cliffs Provincial Park 43

MAPS

1 Vegetation of Mono Cliffs Provincial Park back pocket
2 Significant Areas and Species of Mono Cliffs Provincial Park back pocket

CHAPTER I: REGIONAL BACKGROUND

(i) INTRODUCTION

Mono Cliffs Provincial Park, a 732 ha Natural Environment park, is one of 116 proposed and existing parks forming the Niagara Escarpment Parks System (Niagara Escarpment Commission 1979, p. 33, 42). The park represents the only major exposure of the Niagara Escarpment along its central section, between Credit Forks and Lavender Falls. Land for the park was acquired in the 1960s because of its provincially significant biological and geological features, as well as its spectacular scenery.

The park lies directly north of the small community of Mono Centre in Mono Township, Dufferin County. It can be reached by Dufferin County Road 8, a paved road which runs between Camilla on Highway 10/24, Mono Centre, and Dufferin Road 18, also known as Airport Road (Figure 1).

This biological inventory has been prepared as background information for a Management Plan for Mono Cliffs Provincial Park. Park management plans are revised every ten years by the ministry, and management planning is currently underway. The purpose of this inventory is to document the biological features of the park (*i.e.* its vegetation communities, flora and fauna), to identify significant areas and species, and to provide recommendations regarding park management, based on the analysis of biological information. The inventory also documents features on lands adjacent to the park which are part of the headwater area for McCarston's Lake.

a. Present Use and Development

The park is currently managed from Earl Rowe Provincial Park. It is open for day use only. A system of hiking trails, connected to the three small parking areas around the perimeter of the park, provides access to most of its scenic and significant features (Lindsay 1988, Ontario Ministry of Natural Resources 1988). One part of this trail system is a 5.3 km section of the Bruce Trail, a 736 km hiking trail which extends along the Niagara Escarpment between Niagara and Tobermory (Bruce Trail Association 1988). The only other facilities maintained by the ministry within the park are toilets, picnic tables and garbage receptacles at several locations..

Since its acquisition in the 1960s, the park has become very well known to naturalists, scientists and the general public. In recent years there has been a dramatic increase in the use of the Mono Cliffs area by teachers and students for outdoor education, by Bruce Trail users, naturalist groups, youth groups and other park visitors. Three nearby outdoor education centres, Mono Cliffs (North York Board of Education), Sheldon Creek (East York Board of Education), and Boyne (Toronto Board of Education), use the park on a regular basis. The Ministry of Natural Resources, Huronia District, estimates annual visitation to Mono Cliffs at 30,000. The three parking areas around the perimeter of the park are filled to capacity many week-ends and there are often additional cars parked on adjacent roads as well.

The Mono Cliffs Outdoor Education Centre is located on the south boundary of the park, north of 20 sideroad and west of the 2nd line. This centre, owned and operated by the North York Board of Education, opened in the fall of 1986. The centre has developed trails for cross-country skiing, snowshoeing and outdoor education activities within the park, in the fields and forests on the moraine uplands west of the Niagara Escarpment. The locations of some of these trails were mapped by Lindsay (1988).

Figure 2 shows some of the features of the park which are referred to in this report: the escarpment, the north and south outliers, McCarston's Lake (also known locally as Mono Centre Lake or Mono Lake), its nine ponds and the five streams that rise within the park. It also locates the three small parking areas, adjacent roads, the small community of Mono Centre, the Mono Cliffs Outdoor Education Centre and the Dufferin County Forest.

A snowmobile trail, part of the Orangeville and District Association Trails, crosses the park from the Dufferin County Forest, west of the park on the 1st line, to the 2nd line, and then travels north to 25 sideroad.

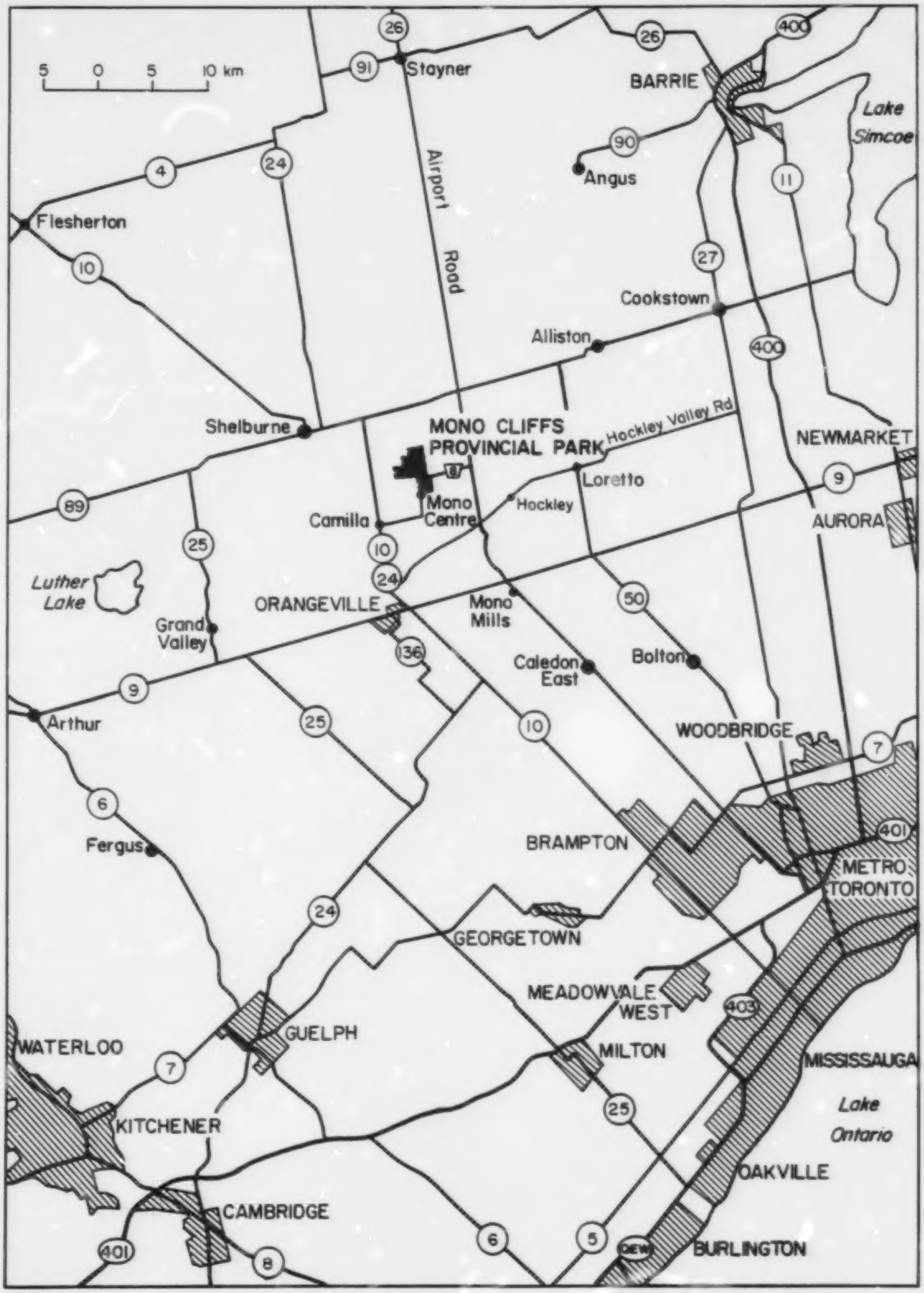

5 0 5 10 km
26
Stayner
91
26
400
BARRIE
Lake Simcoe
90
Angus
24
4
Airport Road
11
Flesherton
10
27
Cookstown
Alliston
400
Shelburne
MONO CLIFFS PROVINCIAL PARK
Hockley Valley Rd
NEWMARKET
8
Loretto
9
89
Mono Centre
Hockley
Camilla
AURORA
25
10
Luther Lake
24
ORANGEVILLE
Mono Mills
50
Grand Valley
136
Caledon East
Bolton
9
Arthur
25
10
WOODBRIDGE
7
6
BRAMPTON
401
Fergus
METRO TORONTO
24
GEORGETOWN
MEADOWVALE WEST
403
GUELPH
WATERLOO
MILTON
MISSISSAUGA
7
25
Lake Ontario
KITCHENER
OAKVILLE
CAMBRIDGE
6
5
401
QEW
BURLINGTON
8

Figure 1: Location of Mono Cliffs Provincial Park

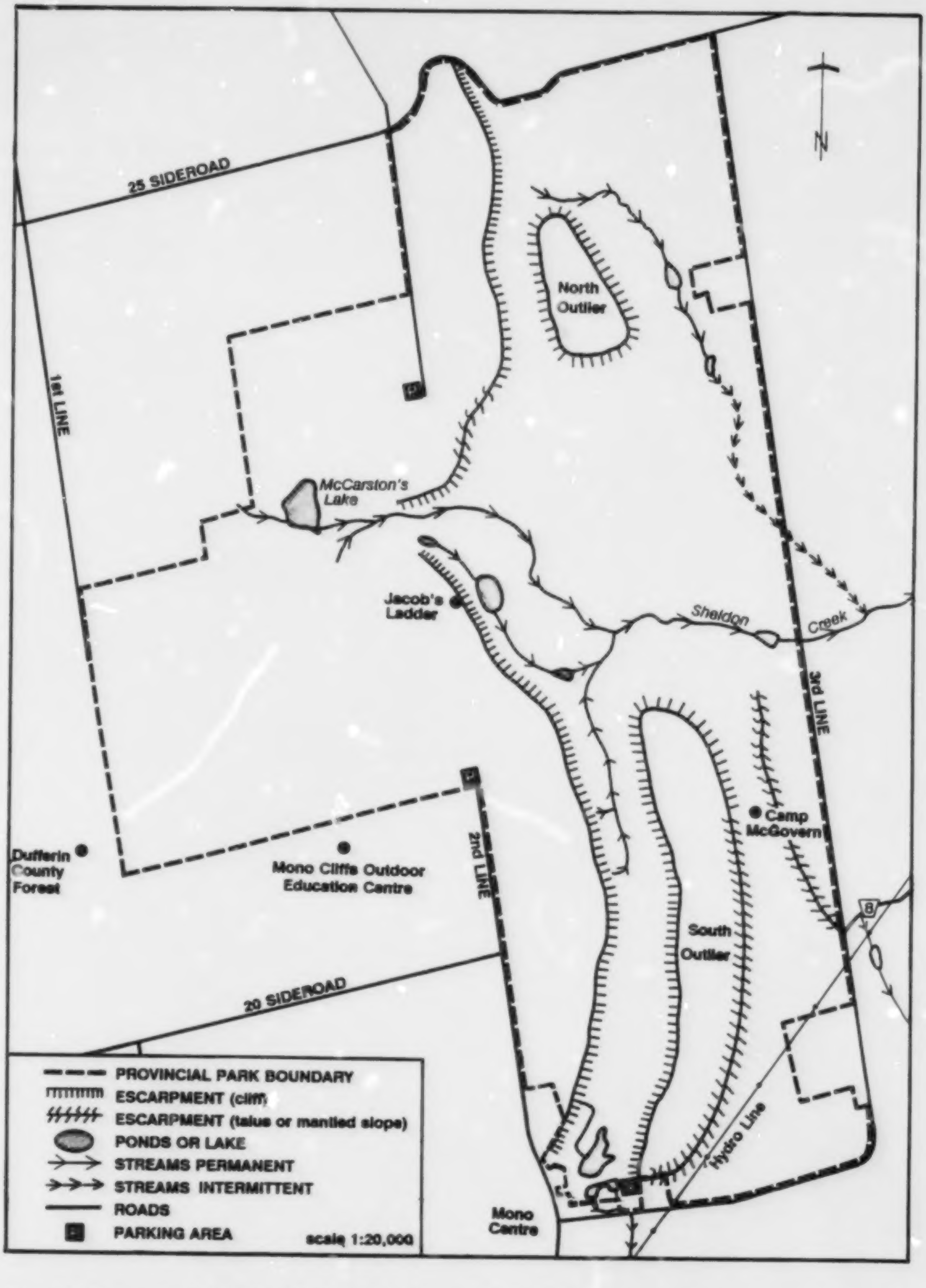

N
25 SIDEROAD
North Outlier
1st LINE
McCarston's Lake
Jacob's Ladder
Sheldon Creek
3rd LINE
Camp McGovern
Dufferin County Forest
Mono Cliffs Outdoor Education Centre
2nd LINE
South Outlier
8
20 SIDEROAD
Hydro Line
Mono Centre
PROVINCIAL PARK BOUNDARY
ESCARPMENT (cliff)
ESCARPMENT (talus or mantled slope)
PONDS OR LAKE
STREAMS PERMANENT
STREAMS INTERMITTENT
ROADS
PARKING AREA
scale 1:20,000

Figure 2: Features and Facilities Within and Adjacent to Mono Cliffs Provincial Park

The Dufferin County Forest, situated on lot 22, concession IE, adjoins the western boundary of the park. It consists of 60 ha of Red Pine, White Pine, White Spruce, Jack Pine, Red Oak and Larch, planted in 1948 and 1949 and restocked in 1959. About 15 ha of this county property are covered by deciduous forests of Sugar Maple, American Beech and White Ash (Township of Mono 1974, p. 53, 54).

Camp McGovern, a private campground run by the Big Brothers Association of Kitchener-Waterloo, is located within the park on the terrace on the east side of the south outlier (Figure 2). The campground currently operates under a Land Use Permit issued by the Ministry of Natural Resources for ten years, renewable annually. The Big Brothers camp was purchased by the Ministry in 1973, with an agreement for 30 years of continued use, due to end in 2003. As well, three parcels of land on the east side of the park are currently leased for grazing (east half, concession III, lots 22-24; south half, concession III, lot 19). A hydro line crosses the southeast corner of the park (Figure 2).

b. Previous Studies and Ongoing Research

The first ecological assessment of the park was conducted by Don Cuddy in 1973 to provide background information for the first park master plan (Cuddy 1973 a,b). Fieldwork for this assessment was carried out during the period June 13-27, 1973. The report, while incomplete, identified 17 significant areas within the park. The park master plan, published in 1974, included a large Natural Zone comprised of "... most of the woodland, rough grass areas and other key ecological areas" (Ontario Ministry of Natural Resources 1974, p. 24, 25). The escarpment, the forests surrounding McCarston's Lake, the two outliers, the wooded outlier valleys, the forests and wetlands along Sheldon Creek and other wetlands in the park were included in this Natural Zone.

The author's interest and knowledge of the Mono Cliffs area, and the Niagara Escarpment in general, extends back over 18 years. She conducted an independent research project on the Flora of the Mono Rocks area in 1973, as an undergraduate at the University of Toronto (Lindsay 1973). During 1975 and 1976, she was one of a team of three biologists (Cuddy, Lindsay and Macdonald) responsible for a comprehensive study of "Significant Natural Areas Along the Niagara Escarpment". More than 300 sites were examined in the field, and 68 were investigated and reported on in detail, including Mono Cliffs. This study identified a large natural area within Mono Cliffs as a provincially significant candidate nature reserve, offering the best representation of escarpment-related features in the Dufferin section of the Niagara Escarpment (Park Planning Branch 1976, p. 127; Lindsay 1976). Since 1973, the author has continued to collect data independently on the natural history of the Mono Cliffs area. As a part-time resident of Mono Township since early childhood, she has followed the history and development of the Mono Cliffs area for over 25 years.

In 1987 and 1988, the author evaluated the trail systems at Mono Cliffs Provincial Park as part of a joint project carried out by the North York Board of Education and the Ministry of Natural Resources and funded by the Ontario Heritage Foundation (Lindsay 1988).

In 1983, Mono Cliffs was also identified as a provincially significant Area of Natural and Scientific Interest or ANSI, for both life and earth science features, in the Huronia District Land Use Guidelines (Ontario Ministry of Natural Resources 1983). The area identified as a provincially significant, life science ANSI was the same as the provincially significant candidate nature reserve identified in 1976 (Park Planning Branch 1976). In 1988, the boundaries of the provincially significant life and earth science ANSIs were mapped by the Regional Ecologist, Central Region on 1:10,000 scale Ontario Basic Mapping, as part of a review of all ANSI and Nature Reserve boundaries in Central Region (Riley pers. comm.). The provincially significant, life science features extend outside the provincial park boundary to include critical headwater wetlands and forests west of McCarston's Lake.

The wetlands along Sheldon Creek within the park were evaluated as part of the Violet Hill Spillway Complex and were considered to be part of provincially significant wetland (Smith and Danials 1987).

This report brings together the natural history observations of other naturalists and scientists who have visited or worked at Mono Cliffs in the past. Individuals with special knowledge of the park's biology were contacted for records of plants or animals. Those who kindly contributed natural history data are listed below and are also referenced in the technical appendices of this report. Some of the observations were collected during the Ontario Breeding Bird Atlas project and the Ontario Herpetofaunal Summary.

Tom Beechey, Senior Conservation Biologist, Parks and Natural Heritage Policy Branch, OMNR
Dr. D.M. Britton, Department of Botany and Genetics, University of Guelph
Mike Cadman, Breeding Bird Atlas Co-ordinator, University of Waterloo
Mr. W.E. Coleman, Mono Township
Don Cuddy, Regional Ecologist, OMNR, Kemptville
Ross Evans, Atlasser, Ontario Breeding Bird Atlas
Mr. Lloyd Fraser, Co-ordinator Outdoor Education, North York Board of Education
Joyce and Bruce Hood, Petawawa, Ontario
James Kamstra, Musselman Lake, Ontario
Phil Kor, Niagara Escarpment Project Geologist, OMNR, Aurora
Jack Imhof, Provincial Aquatic Habitat Biologist, Fisheries Branch, OMNR
Dr. D.W. Larson, Cliff Ecology Research Group, University of Guelph
Bob Law, District Planning Co-ordinator, OMNR, Midhurst
Dr. D.H. Lynn, Department of Zoology, University of Guelph
Alex Mills, Barrie, Ontario
Dr. J.H. McAndrews, Department of Botany, Royal Ontario Museum
Mike Oldham, District Ecologist, OMNR, St. Thomas
John Riley, Regional Ecologist, OMNR, Aurora
Chris Risley, Atlasser, Ontario Breeding Bird Atlas and Author of Status Report on Eastern Bluebird
Dr. H. Savage, Faunal Archaeo-Osteology Laboratory, Department of Anthropology, University of Toronto
Leo Smith, Brantford, Ontario
Steve Varga, Natural Areas Biologist, OMNR, Aurora
Greg Warchol, Mississauga, Ontario
John Winters, Parks Supervisor, OMNR, Midhurst

Recent scientific studies of the natural features of the park, and the park in the context of the Niagara Escarpment in general, have included the following: Mole Salamanders of the Niagara Escarpment (Bogart 1991), studies of ferns and fern allies (Britton 1981, pers. comm.); a faunal study of McCarston's Lake (Kott and MacRae-Mitchell 1990); five transects sampled along the cliffs as part of an ecological study of the old growth White Cedar forests associated with Niagara Escarpment cliffs (Larson 1989); microbes of the Niagara Escarpment (Lynn and Olson 1990); analysis of lake sediments and reconstruction of postglacial history of the escarpment (McAndrews 1990); a faunal study of a deep fissure cave (Savage 1990); analysis of pollen in cave sediments (McAndrews and Campbell 1990); and two forest stands sampled as part of a quantitative study of forests of the Niagara Escarpment (Varga pers. comm.). These studies are discussed in greater detail in Chapter I iii), II and III and in the technical appendices of this report.

c. Methods

Work on this project began in early August 1989. Discussion with parks staff at the regional and district offices of the Ministry of Natural Resources were held early in the study. The background information available for the Mono Cliffs area (biological and geological reports, maps, airphotos) was reviewed before planning fieldwork.

The different habitats and geographic areas of the park were visited several times during the growing season (mid-April to mid-October) to document vegetation, physical conditions, flora and fauna. At selected points within vegetation communities, data on tree sapling and ground layers, terrain, site, disturbance and significant species were recorded. Life science features were documented with black and white and 35 mm colour photography. Voucher specimens were made of significant or unknown plant species. Vegetation, significant features and field routes were mapped in the field on air photo overlays (1:10,000 scale). Copies of the field data sheets completed for the vegetation communities of the park and the specimen data from plant collections will be filed at the Southern Region office of the Ministry of Natural Resources, Aurora. All specimens collected during this biological inventory and between 1973 and 1991 will be deposited in the herbarium of the Royal Ontario Museum (TRT).

A total of 21 full days were spent on fieldwork in 1989, 1990, and 1991, spread out over 40 days. The dates of field work were 14, 16-18, 30 August; 9, 10, 11, 14, 24, 30 September; 1, 4, 11, 12, 18 October 1989; 14 January; 17 March; 19, 28, 30 April; 2, 9, 13, 14, 23, 25 May; 2, 9, 17, 21 June; 1, 2 August; 9 September; 3, 10 November 1990; 6, 12, 13 January; 9 February 1991. A site visit with Tom Beechey, the ministry's representative for this project, on 22 November 1989 allowed discussion of work completed, vegetation mapping and classification, significant features, and the impacts of recreational use on sensitive areas. On August 6, 1989, the author attended a field trip on the Ferns and Fern Allies of Mono Cliffs, led by Dr. Don Britton of the University of Guelph, for scientists attending the American Institute of Biological Sciences (AIBS) Conference in Toronto.

Four early morning surveys were devoted entirely to atlassing breeding birds; a total of 9 hours on 25 May and 2, 9, 17 June 1991. Other observations of breeding birds were made during field surveys of different habitats and geographic areas in the park. Fall and winter visits allowed an assessment of park use at these seasons. The coring of lake sediments through the ice at McCarston's Lake was documented photographically on 13 January and 9 February 1991 (McAndrews 1990).

The vegetation communities in the park were mapped initially on overlays at 1:10,000 scale based on: interpretation of 1978 aerial photography at 1:10,000 scale; interpretation of 1988 aerial photography at 1:20,000 scale, without deciduous leaf cover; and fieldnotes made in 1989-1991, 1987 and earlier years. The 1988 photography was useful in delineating boundaries of mixed and coniferous communities, and checking land use changes such as beaver floods and new trails.

Scientists, naturalists and individuals with a special knowledge of the park were contacted for information on its natural history. Those who kindly contributed information are listed in the previous section, Chapter I ii) b), and are also referenced in the technical appendices of this report.

(ii) PHYSICAL AND HISTORICAL BACKGROUND

a. Geology and Physiography

Within Mono Cliffs Provincial Park, the Niagara Escarpment and two dolostone outliers are exposed along the edge of a meltwater drainage channel, part of the Violet Hill Meltwater Spillway. This is the only major exposure of the Niagara Escarpment along its central section. The Niagara Escarpment extends from the Niagara River to the northern tip of the Bruce Peninsula and the Manitoulin Islands in Ontario, as a topographic break formed of cliffs and slopes of Palaeozoic bedrock. Between Credit Forks, in the Town of Caledon, and Lavender Falls, in Nottawasaga Township, the slopes of the Niagara Escarpment are largely mantled by moraine and outwash deposits.

The escarpment face crosses the park in a north-south direction, with an indentation, a small re-entrant valley, along the stream flowing out of McCarston's Lake. Vertical dolostone cliffs of the Amabel Formation drop from the brow of the escarpment and the two outliers. Below the cliffs of the Niagara Escarpment and its outliers are steep talus slopes covered by an accumulation of dolostone boulders and bigger dolostone blocks. Narrow valleys separate the outliers from the escarpment face; the north outlier and its valley are smaller than the south outlier and the south outlier valley. Although the contact is not visible, the zone of contact between Amabel dolostone and Cabot Head shale, along the talus slopes and mantled slopes of the main escarpment face, is characterized by many springs and seepage areas. The contact between Manitoulin dolostone and Whirlpool sandstone is visible at a small waterfall along Sheldon Creek at UTM 744773. Whirlpool sandstone and Queenston shale bedrock are exposed on a slope along the 3rd line at UTM 754763.

Sandy moraine deposits related to the Orangeville Moraine lie above the escarpment (Gwyn 1972). The terrain is steeply rolling, kame and kettle topography. McCarston's Lake is a kettle lake. These moraine uplands hold several other kettle wetlands with mixed swamp, bog and marsh vegetation. The level to rolling, sand and gravel plain at the base of the escarpment is composed of outwash material deposited by meltwater flowing south along the Violet Hill Meltwater Spillway. It is thought that this spillway drained all waters from Singhampton south to the Hockley Valley, where drainage to the east was blocked by an ice front (subsequently the Singhampton Moraine). From there drainage was towards Orangeville and the Orangeville-Brantford Spillways south to proglacial Lakes Whittlesley and Arkona (Riley 1983).

Above the escarpment, elevations range from 525.5 m, the highest point of land in the park at its northwest corner, to 470.0 m. The floor of the north outlier valley on the spillway plain is at a higher elevation (457.5 m) than the floor of the south outlier valley (438.0 m). The cliffs of the escarpment range from 3 m to over 30 m in height. The wetlands along the 3rd line are the lowest point in the park at 399.5 m. In all, the topographic range within the park is 126 m.

b. Hydrology

The park is a headwater source for Sheldon Creek, and another tributary of the Nottawasaga River, which flows in a generally northerly direction to enter Georgian Bay at Wasaga Beach. McCarston's Lake and four of the five streams that rise in the park and flow through it drain to the east, into Sheldon Creek (See Figure 2 and Map 1). Springs and seepage areas rise along the main escarpment face, at the northern tip of the north outlier, beneath the eastern, lower slope of the south outlier west of the 3rd line, and along the valley of Sheldon Creek, and feed into these streams.

In addition to McCarston's Lake, which is the only natural lake in Mono Township, there are eight man-made ponds within the park and one pond created by a beaver dam. Prior to 1986, there was one more man-made pond. The dam of the southerly pair of ponds on the glacial spillway near the Carriage Trail broke in 1986 or 1987, and it has not yet been reconstructed. The three ponds at the south end of the south outlier valley, by Mono Centre, flow into a stream that drains southward to join the Nottawasaga River in the Hockley Valley east of Glen Cross.

c. Soils and Substrate Types

The soil types mapped in the park by Hoffman *et al.* (1964) are primarily loams, fine sandy loams, sandy loams and loam sand with good drainage. These have developed on stoney loam till, outwash fine sand, outwash sand and loam material over outwash gravel parent materials. These soil types are found on the sandy moraine deposits, west of the escarpment and on top of the north outlier, and on the sand and gravel outwash plain at the base of the escarpment. The escarpment with its primary bedrock sites was mapped separately. An area of clay soil with good drainage, developed on clay till parent material, was mapped on the plateau of the south outlier and on the terrace at its base. Great Brown Podzolic, Brown Forest and Podzol Great Groups are represented. Muck and organic soils underlie most of the wetlands in the park.

For the purpose of site classification on the Vegetation Matrix (Figure 3), the soil types found in the park were grouped into five broad substrate types. Escarpment habitats with little or no soil, or shallow soils up to 15 cm in depth were classed as **rock**. The loam sand and certain of the sandy loam sites on outwash gravel on the spillway plain were classed as **sand**. The loams, fine sandy loams and sandy loam soils were classed as **loam**, the clay soils as **clay** and the mucks as **organic**.

d. Climate and Microclimate

Mono Cliffs lies on the eastern side of the Dundalk Upland Climatic Region (Chapman *et al.* 1980, Putnam and Chapman 1938), a region characterized as the most elevated part of southern Ontario, with elevations from 300 m to over 500 m. The average length of the growing season is 190 days (April 20-October 25). The average length of the "frost-free" period is 128 days, with the mean date of the last spring frost May 20, and the mean date of the first fall frost September 25. The mean annual precipitation is 81 cm, and the mean annual snowfall is about 183 cm.

There is considerable variation in microclimate within the park. The slopes of the escarpment and its two outliers face in all directions of the compass. The vegetation on north and east-facing escarpment slopes is influenced by normal and colder-than-normal microclimates, while the vegetation of south and west-facing slopes is effected by normal or warmer-than-normal microclimates. The rim and cliffs of the escarpment are very exposed to seasonal environmental fluctuations. Fall frosts were observed to be later in sheltered locations in the outlier valleys. Kettle depressions on the moraine that hold snow and cold air drainage have colder-than-normal microclimates. Spring-fed swamps and wetlands are also influenced by colder-than-normal microclimates. The variations in microclimate associated with different habitats and vegetation communities in the park are discussed in Chapter II ii) and illustrated on the Vegetation Matrix (Figure 3).

e. History

Settlers began to move into Mono Township in the early 1820s, shortly after the surveying of the township had begun (Turnbull 1988, p. 7). In a historical study of the settlement of Mono Township, Harris *et al.* (1975, p. 4) present a map of the forests of Mono *circa* 1820, compiled from data from the surveyor's notes. The forests of the park are mapped mainly as Maple, Beech, Basswood, Elm, Hemlock, with an area of Maple, Beech, Hemlock on the west side in concession 2, and a small area of Cedar Swamp along the 3rd line. In 1843, the park area was completely forested, except for three small clearings adjacent to farmhouses, of about 4 to 8 ha in size (Harris *et al.* 1975, p. 12).

The early forests of Mono Township are described in "The Green Hills of Mono", a history of reforestation in the township (Township of Mono, 1974, p. 1). "Maple, Beech and Basswood predominated on the uplands, with Hemlock where moisture was plentiful. The slopes had Elm and Soft Maple while in the lowlands there was an abundance of Cedar, Balsam and Tamarack. Pine was not very prevalent, though there was a sizable stand of it on the 1st concession, 20 sideroad." Except for six large White Pine in concession 2, lot 22, Pine is absent from the natural forests of the park today. A small stand of about 60 naturally seeded, young, White Pine (to 9 m in height, 15 cm d.b.h.) grows in the old field adjacent to the large White Pine. A few scattered, large White Pine are also found in lots 19, 20 and 21, concession 2, south of the park, close to the location described in "The Green Hills of Mono".

Pollen analysis has been completed by McAndrews (1990, pers. comm.) for the top 8.9 m of lake sediments, the last 9,290 years, immediately underlying the bottom of McCarston's lake. The calculation of the tree biomass of the forests surrounding the lake over the past 7,600 years, shows there to have been forests of similar composition over that time. Sugar Maple, Beech, Elm, Birch, and Ash have been consistently important species in the forest. Other species present in the sediments throughout the period are Balsam Fir, Cedar, Ironwood and Hickory.

For the period 9,290 to 7,600 years before present, the consistently important species in the forest were Birch, Balsam Fir, Pine, Ash, Elm and Oak. The bottom of the lake sediments has not yet been reached. Additional sampling is planned for the winter of 1992. The glacial sediment should be at 10 m.

Around 1850, with settlement and the clearing of the forests for agriculture, Grass (Gramineae), Ragweed (*Ambrosia*) and associated pollen appear in the lake sediments. The decline of White Elm due to the spread of Dutch Elm disease in the 1950s is also evident in the pollen record.

Another of the interesting findings was the very small amounts of Pine and Oak pollen in the tree biomass calculations for the forests surrounding McCarston's Lake over approximately the last 6,000 years. There are no Oak and very few White Pine in the natural forests of the park today. McAndrews (pers. comm.) suggests that this may be related to a wetter, cooler climate in the Dundalk Upland Climatic Region and to moister soil conditions.

McAndrews and Campbell (1990) analysed fossil pollen from silty deposits collected at two sites in a deep fissure cave within the park. Both sites had an upper zone of weed pollen (Ragweed zone) from the last 150 years. The bottom of one site had "... rather abundant pollen of the modern forest and therefore dates from zone 3 (Hemlock zone) that spans 7,600-150 years B.P.". The lower three levels of the other site contained pollen of a small *Pinus* together with a few *Abies* and fit "... into zone 2a which spans 10,500-9,000 years B.P.".

With the exception of some escarpment communities, such as the old growth White Cedar forests along the cliff-edge and cliff-face, most of the park has been logged selectively or cleared for agriculture over the past 150 years since settlement. The White Cedar forests associated with cliffs at Mono Cliffs and along the Niagara Escarpment are some of the oldest, most intact, old growth forests in eastern North America (Larson 1989, 1990, pers. comm.). At a small sample site in the park, Larson found trees greater than 300 years in age. One tree sampled in the park was 428 years in age and several were in the 350 to 400 year range. Elsewhere along the escarpment he sampled trees greater than 500 years in age, and found dead stumps on the talus below the cliffs with ages greater than 1000 years.

Talus slopes and rim forests on the north and south outliers show signs of past fires. Much of the non-escarpment natural area in the park was accessible to grazing farm animals until the 1960s when land for the park was acquired. The oldest plantation in the park, the Red and White Pine planted in the "Ravine" or south outlier valley, dates from the 1930s (Coleman pers. comm.).

(iii) REGIONAL CONTEXT OF VEGETATION

Mono Cliffs is located in the Huron-Ontario section of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). This forest region is also known as the Southern Deciduous-Coniferous Forest Region (Maycock 1979). It falls within the Uxbridge Site District 6-7 of the Lakes Simcoe-Rideau Site Region 6E (Hills 1959).

Site District 6-7 is one of the fifteen site districts in Site Region 6E. A site region is defined as an area of land within which the response of the vegetation to the features of the landform follows a consistent pattern (Hills 1959). Site Region 6E is described as a gently undulating to rolling landscape with ice-laid material deeply covering the bedrock over 80 percent of the area. According to Hills (1959, p. 120), normal, mesic sites in Site Region 6E are typically forested with Sugar Maple, Beech and Hemlock. Normal, dry sites support Sugar Maple, Oak and Ash and hot, dry sites are characterized by Oak and Ash. White Pine, Elm and Ash grow on cold, dry sites. Hemlock, Yellow Birch, Spruce and White Cedar occur on wet sites.

Each site region is subdivided into site districts based on landforms which set apart fairly large areas. Hills (1959, p. 121) described the Uxbridge Site District (6-7) as "an area of deep, very high lime sand and gravel, overlain locally by very high lime clay, silt and loam". The district extends about 200 km in length from Caledon to Brighton Townships, varying in width from 13 to 20 km.

CHAPTER II: MONO CLIFFS PROVINCIAL PARK

(i) INTRODUCTION TO VEGETATION

At Mono Cliffs Provincial Park, the escarpment face and two large dolostone bedrock outliers are exposed along the edge of a glacial spillway. This is the only major exposure of the Niagara Escarpment along its central section. Between Credit Forks and Lavender Falls, the Niagara Escarpment is largely buried by moraine and outwash deposits.

The escarpment face crosses the park in a north-south direction, with an indentation, a small re-entrant valley, along the stream flowing out of McCarston's Lake. Narrow valleys separate the outliers from the escarpment face; the north outlier and its valley are smaller than the south outlier and south outlier valley. Habitats associated with the main escarpment and the north and south outlier faces support a complex of distinctive vegetation communities and provide specialized niches for an escarpment-related flora, rich in ferns and fern allies. Species such as Green Spleenwort (*Asplenium viride*), Walking Fern (*Camptosorus rhizophyllous*), Smooth Cliff-brake (*Pellaea glabella*) and Hart's-tongue Fern (*Phyllitis scolopendrium*), are restricted to limestone rock habitats in the park, along the Niagara Escarpment, and elsewhere in southern Ontario. A wide range of physical sites and vegetation types are associated with the thinly-soiled bedrock pavement rim at the cliff-edge, the high and low cliffs and cliff-face fissure systems, the talus slopes and steep bedrock-controlled slopes. The bedrock exposures of the escarpment and the two outliers are aligned in all directions of the compass, from east-facing to south-facing, and this diversity of slope aspect augments the overall diversity of vegetation-site types in the park.

Recent ecological studies of the White Cedar forests growing along the cliff-edge and on the cliff-face of the Niagara Escarpment, suggest that these forests are some of the oldest, intact, old growth forests in eastern North America (Larson 1989, 1990, pers. comm.). These Niagara Escarpment cliff forests escaped the widespread logging of upland forests that occurred with the settlement of southern Ontario, in the last half of the 19th century. White Cedars sampled by Larson at Mono Cliffs had ages greater than 300 years (Larson pers. comm.).

Deciduous forests dominated by Sugar Maple cover the sandy, steeply rolling moraine uplands lying west of the escarpment, and completely surround the headwaters and watershed of McCarston's Lake, the only natural lake in Mono Township. Mixed forest lines the steep slopes along the eastern shore of McCarston's Lake. A concentration of mixed forest occurs at the south end of the park, in the south outlier valley, along some slopes of the south outlier and on the plateau of the south outlier. Mixed forest also grows on some mantled escarpment slopes, borders some sections of stream courses, and occurs as small stands in other locations scattered about the park.

Above the escarpment, wetlands such as mixed swamp and a very small example of open low shrub bog and treed bog are found in kettle depressions of the moraine west of McCarston's Lake. A series of wetlands, mainly mixed swamp, conifer swamp and marsh occur below the escarpment, fed by springs which rise along the escarpment face, in the valley of Sheldon Creek, and on the eastern slopes of the outliers, in zones where the overlying dolostones contact impervious shales. These wetlands extend south along the main escarpment face from the incised stream valley leading out of McCarston's Lake, fill the north and south sections of the south outlier valley, line the valley of Sheldon Creek west of the 3rd line, lie beneath the eastern lower slope of the south outlier west of the 3rd line, and at the northeastern tip of the north outlier.

In addition to McCarston's Lake, there are eight man-made ponds within the study area and one pond created by a beaver dam. Prior to 1986, there was one more man-made pond. The dam of the southerly pond of the pair of ponds on the glacial spillway near the Carriage Trail broke in 1986 or 1987, and it has not yet been reconstructed. Emergent vegetation occupies shallow water areas of the ponds and McCarston's Lake. Meadow marsh is found along the shorelines of the ponds and lakes and along open sections of the five streams that rise in the park and flow through it.

At present, anthropogenic vegetation such as fields, hawthorn savanna, and plantation occupies the majority of the park's environment. About 150 years ago, the park area was completely forested, except for three small clearings adjacent to farmhouses (Harris *et al.* 1975, p. 12).

Since the park's acquisition in the 1960s, some very positive changes have occurred to the natural vegetation. Its forests have matured, many fields have developed diverse successional communities which complement these forests and the removal of grazing from forests and talus slopes has improved forest regeneration and has probably increased the frequency of fern and moss communities.

(ii) COMMUNITY DESCRIPTIONS

For discussion and mapping purposes, the 53 vegetation communities of Mono Cliffs Provincial Park have been grouped into the following categories: Terrestrial (Forest), Primary (Escarpment), Palustrine (Wetland), Lacustrine (Open Water) and Anthropogenic (Human-modified). The location and extent of these communities is shown on Map 1, Vegetation. Each water body grouped under the Open Water (Lacustrine) category is identified separately on the map and discussed individually in the section that follows.

The vegetation communities have been mapped at 1:7,500 scale for presentation purposes (Map 1). Initially, the vegetation communities in the park were mapped at 1:10 000 based on: interpretation of 1978 aerial photography at 1:10 000 scale, interpretation of 1988 aerial photography at 1:20,000 scale, without deciduous leaf cover, and fieldnotes made in 1989-1991, 1987 and earlier years. The 1988 photography was useful in delineating boundaries of mixed and coniferous communities, and checking land use changes such as beaver floods and new trails. Because there are few natural communities with distinct boundaries, the lines delineating the vegetation communities on Map 1 must be regarded as best approximations.

In the discussion that follows, each vegetation community is described in terms of its location, extent and relationship to physical features of the park. Site parameters, *i.e.* substrate type, soil moisture regime and microclimate, are outlined according to the site classification approach presented in the Revised Report Format and A Framework for the Conservation of Ontario's Biological Heritage (Ontario Ministry of Natural Resources 1976, 1980). Detailed descriptions of the tree, sapling and ground layers are given and any significant species are discussed. Any additional research in a community by outside researchers is briefly reviewed.

The vegetation communities of Mono Cliffs Provincial Park and their approximate areal extent are given on Table 1. The relationship of the vegetation communities to the environmental parameters of substrate type, soil moisture regime and microclimate is summarized in a Vegetation Matrix (Figure 3).

TERRESTRIAL – FOREST

Deciduous and mixed forest types cover approximately 206.9 ha or 28 percent of the park area.

1 DECIDUOUS FOREST

Deciduous forests predominate on the steeply rolling moraine uplands lying west of the escarpment, on the moraine deposits on top of the two outliers and below the escarpment in several locations on the outwash plain, covering in total an approximate area of 161.9 ha. Forests dominated by Sugar Maple have been grouped into three types, based on the subdominants in the stands surveyed.

1A Sugar Maple – American Beech
1B Sugar Maple – Black Cherry
1C Sugar Maple – White Birch – Ironwood – White Ash

Table 1: Size of Vegetation Communities of Mono Cliffs Provincial Park

		Vegetation Community	Approximate[1] Size (ha)	Relative Size (%)
TERRESTRIAL – FOREST			**206.9**	**28.0**
1		DECIDUOUS FOREST	161.9	21.9
	A	Sugar Maple – American Beech	66.0	8.9
	B	Sugar Maple – Black Cherry	46.4	6.3
	C	Sugar Maple – White Birch – Ironwood – White Ash	21.2	2.9
	D	White Birch – Sugar Maple – Large-toothed Aspen	9.6	1.3
	E	Butternut – Sugar Maple – Large-toothed Aspen	1.1	0.2
2		MIXED FOREST	44.9	6.1
	A	White Cedar – White Birch	9.9	1.3
	B	White Birch – Trembling Aspen – White Cedar	3.4	0.5
	C	Sugar Maple – Eastern Hemlock – White Cedar	14.3	1.9
	D	Sugar Maple – White Birch – Large-toothed Aspen – Eastern Hemlock	5.3	0.7
	E	Red Maple – Black Cherry – Eastern Hemlock	1.1	0.2
	F	Sugar Maple – Eastern Hemlock – White Ash – American Beech	3.3	0.5
PRIMARY – ESCARPMENT			**57.4**	**7.8**
3		BEDROCK PAVEMENT RIM White Cedar – White Birch	6.6	0.9
4.		CLIFFS	6.5-10.0[1,2]	0.9-1.4
	A	Cliffs > 10 m		
	B	Cliffs > 3 m and < 10 m		
	C	Cliff-face Fissure Systems		
5		TALUS AND STEEP BEDROCK SLOPES	40.8[1]	5.5
	A	White Cedar – White Birch	16.7	2.3
	B	White Birch – White Ash – White Cedar – Sugar Maple	2.8	0.4
	C	Sugar Maple – Butternut – Basswood – Yellow Birch	7.9	1.1
	D	Sugar Maple – White Ash	13.4	1.8
PALUSTRINE – WETLAND			**36.3**	**5.0**
6		MIXED SWAMP	24.1	3.3
	A	Hemlock – Red Maple – Yellow Birch	2.8	0.4
	B	Red Maple – Black Ash – White Birch – White Cedar – Balsam Fir	4.7	0.6
	C	Yellow Birch – White Cedar – Eastern Hemlock – Balsam Fir – Black Ash	8.6	1.2
	D	White Cedar – Yellow Birch	4.5	0.6
	E	Tamarack – White Spruce – White Cedar – Balsam Fir – White Birch – Black Ash	2.5	0.3
	F	White Cedar – White Birch – White Spruce	1.0	0.1

Table 1: Size of Vegetation Communities of Mono Cliffs Provincial Park (cont'd)

Vegetation Community			Approximate[1] Size (ha)	Relative Size (%)
7	CONIFER SWAMP		6.5	0.9
		White Cedar		
8	BOG		0.1	–
	A	Open Low Shrub Bog		
	B	Treed Bog		
9	MARSH		5.6	0.8
	A	Shrub-rich Marsh	2.0	0.3
	B	Meadow Marsh	1.8	0.2
	C	Cattail Marsh	0.1	–
	D	Emergent Marsh	1.7	0.2
LACUSTRINE – OPEN WATER			**7.9**	**1.1**
10	A	Natural Lake	2.6	0.4
	B	Beaver Pond	0.9	0.1
	C-K	Man-made Ponds	4.4	0.6
ANTHROPOGENIC – HUMAN-MODIFIED			**430.7**	**58.3**
11	FIELDS		397.1	53.7
	A	Pasturelands (grazed, mowed or cultivated recently)	171.3	23.2
	B	Old Fields with Successional Thickets	202.8	27.4
	C	Old Fields with Self-seeded Scotch Pine	23.0	3.1
12	HAWTHORN SAVANNA		9.8	1.3
13	PLANTATION		23.8	3.2
	A	Red Pine – White Pine	2.9	0.4
	B	White Spruce	0.6	0.1
	C	Scotch Pine	6.2	0.8
	D	Jack Pine	1.9	0.3
	E	White Pine – Scotch Pine – White Spruce	8.4	1.1
	F	Old Field with Plantation	3.8	0.5

[1] Sizes were calculated with a digital planimeter from the unit boundaries on Map 1, Vegetation, which is based on an uncorrected airphoto mosaic. This method underestimates the sizes of vertical or steeply sloping communities such as cliffs or talus slopes.

[2] Area estimates of the cliff communities were calculated based on an estimated average height for the more than 6 km of cliffs exposed in the park.

Moisture regime Substrate and Temperature		Arid	Very Dry	Dry	Dry Mesic	Mesic	Wet Mesic	Wet	Very Wet	Sat-urated	Open Water
Colder	**Rock**	4A	3,4A,B	3,4B	4C,5A	4C,5A,D	4C,5A,D				
	Sand					2A,C	2A				
	Loam				12	2A,C,E	2A				
	Clay					2C					
	Organic						6A,B,D,7	6A,B,D,E, F,7,9A	6A,B,D,E, F,7,8A,B, 9A	6A,B,D,E, F,7,8A,B, 9A	6A,B,D,E, F,7,8A,B, 9A
Normal	**Rock**	4A	3,4A,B	3,4B	11B	5C,D	5C,D				
	Sand				1D,11B, 13A, E	1A,2A,B, 13A					10K
	Loam				1A,B,C,D, 2A,11A, B,11C,12, 13B,D,F	1A,B,C, 2A,C,D	1A,B,C				10B-D, 10F-K
	Clay				2A,11B, C,13C	1A,2F,5D, 11B,C,13C					
	Organic						6C	6C,9B	6C,9B,C	6C,9B,C	6C,9D, 10A
Warmer	**Rock**	4A	3,4A,B	3,4B	5B						
	Sand				2C						
	Loam				1A,C,2C, 12	1A,C,E					
	Clay										
	Organic										

Legend – Refer to Vegetation Communities in Table 1, p. 12.

Figure 3: Vegetation Matrix for Mono Cliffs Provincial Park

Together these three types comprise 83 percent of the deciduous forest in the park. They grow on sand, loam and clay soils, on level to gently or steeply rolling terrain with occasional to frequent boulders present. The soil moisture conditions are mostly mesic, although dry mesic sites occur on ridges, and wet mesic conditions prevail in small depressions and kettles where moisture collects or on slopes with seepage. Generally the microclimate of these forests was considered to be normal. A few sheltered locations on slopes of the outlier valleys were considered to have warmer-than-normal microclimates. It was observed that fall frosts were later in these sheltered locations.

The deciduous forests of the park typically include a range of age classes from sapling to 46 cm d.b.h. Tree species found in association with Sugar Maple include American Beech, Black Cherry, White Birch, Ironwood, White Ash, Basswood, Butternut, and Large-toothed Aspen. The tree canopy is almost completely closed, 90 to 95 percent closure. Saplings and seedlings of Sugar Maple, and the other tree species in these stands, usually form a reproductive layer. Red-berried Elder (*Sambucus pubens*), Alternate-leaved Dogwood (*Cornus alternifolia*), Canada Gooseberry (*Ribes hirtellum*) and occasionally Leatherwood (*Dirca palustris*) are the only shrub species found.

In these deciduous forests, the show of spring-blooming wildflowers and sedges is impressive in late April and May. These species flower and set seed early in the spring before the leaves of the Sugar Maple are fully open. At this time, the greatest amount of sunlight reaches the forest floor. A rich diversity of herbaceous species is found in the ground layer, including: Broad-leaved Spring Beauty (*Claytonia caroliniana*), Yellow Trout Lily (*Erythronium americanum)*, Common and Purple Trillium (*Trillium grandiflorum, T. erectum*), Squirrel Corn (*Dicentra cucullaria*), Wild Leek (*Allium tricoccum*), Blue Cohosh (*Caulophyllum thalictroides*), Canada Violet, Downy Yellow Violet and Dog Violet (*Viola canadensis, V. pubescens* and *V. conspersa*), Solomon's-seal (*Polygonatum pubescens*), False Solomon's-seal (*Smilacina racemosa*), Wild Ginger (*Asarum canadense*), Bellwort (*Uvularia grandiflora*), Jack-in-the-pulpit (*Arisaema triphyllum*), Wild Lily-of-the-valley (*Maianthemum canadense*), Glandular, Marginal and Spinulose Wood Ferns (*Dryopteris intermedia, D. marginalis*, and *D. carthusiana*), Northeastern Lady Fern (*Athyrium filix-femina*) and the woodland sedges (*Carex gracillima, C. peckii, C. pendunculata* and *C. leptonervia*). Later in the summer, there are several locations where Jewelweed (*Impatiens pallida*) forms a continuous ground cover.

Six large White Pine (30 to 46 cm d.b.h.) grow along the edge of the deciduous forest near UTM 730765. These White Pine were the only pine found in the natural forests of the park. The other pine trees observed in forests in a few locations were thought to be planted.

Included in community 1C are a number of younger successional stands, and stands with scattered large trees mixed with a majority of younger stems. The two other types of deciduous forest that were surveyed and mapped are discussed below.

1D White Birch – Sugar Maple – Large-toothed Aspen

A band of White Birch – Sugar Maple – Large-toothed Aspen forest lines the western edge of the deciduous forest growing on top of the north and south outliers. Other small examples of this forest type occur at several locations west of the escarpment, between the escarpment rim and the forest edge, at UTM 737793, 738781 and 738774. In total, this forest type covers approximately 9.6 ha of the park.

In the spring, the crowns of the Large-toothed Aspen have a silver-white cast created by the dense, white, silky pubescence of the young leaves. The leaves of the Large-toothed Aspen expand later than Sugar Maple and are still only partly open at the beginning of June. From many vantage points in the park, the silver-white crowns of the Large-toothed Aspen in these forests stand out against the new greens of the Sugar Maple and White Birch and the reddish-brown leaves of the Red Maple.

On the north outlier, the young, semi-open forest of White Birch, Sugar Maple, Large-toothed Aspen and occasional Black Cherry and White Ash has a parkland appearance. Trees range from sapling to 20 cm d.b.h. in size and canopy closure varies from approximately 65 to 80 percent. A burnt tree trunk lying on the ground provides evidence of past fire. The site is a sandy ridge, with frequent limestone boulders, running along the western edge of the north outlier. The community also extends along the south rim of the north outlier in a narrow band.

An older forest of White Birch, Sugar Maple, Red Maple and Large-toothed Aspen, with occasional American Beech, White Ash and Black Cherry grows along the western rim of the north half of the south outlier, on flat to gently undulating terrain. Trees range from sapling to 36 cm d.b.h. Juneberry or Serviceberry (*Amelanchier spicata* var. *spicata*) also occurs. The Niagara Escarpment plain stand sampled by Varga in 1981, as part of a quantitative study of the forests of the Niagara Escarpment, is located within this unit (Varga pers. comm.).

The ground layer in both stands is about 70 percent continuous, and the following species dominate: Rough-leaved Mountain Rice (*Oryzopsis asperifolia*), While Lily-of-the-Valley (*Maianthemum canadense*), Bracken (*Pteridium aquilinum*), Wild Sarsaparilla (*Aralia nudicaulis*) and sedges (*Carex arctata, C. eburnea*).

The composition of the other small stands of White Birch – Sugar Maple – Large-toothed Aspen within the park was similar to that described above for stands on the north and south outliers. At all the locations studied, this forest type was associated with a dry mesic, sandy loam site and a normal microclimate. The interesting pattern of occurrence shown by this forest type could be related to: increased light conditions close to the cliff rim or forest edge, thin soils at sites close to the cliff rim, and disturbance history. All of these other small forests are young to middle-aged successional stands.

1E Butternut – Sugar Maple – Large-toothed Aspen

Two small stands of deciduous forest dominated by Butternut, with Sugar Maple and Large-toothed Aspen as co-dominants, were mapped as a separate unit comprising 1.1 ha in total. These forests grow at the north end of the park, on the gentle slopes of the outwash valley between the main escarpment and the north outlier, at UTM 740788 and 741788.

The site is mesic loam and slopes down slightly to the open fields in the valley bottom. Most trees are 25 to 36 cm d.b.h. Degree of canopy closure was estimated at 70 to 80 percent. Microclimate was classed as warmer-than-normal because of the location on the slopes of a sheltered valley. The sapling layer is composed of Sugar Maple (*Acer saccharum*), White Ash (*Fraxinus americana*), Mountain Maple (*Acer spicatum*), Alternate-leaved Dogwood (*Cornus alternifolia*), Hawthorn (*Crataegus* spp.) and Ironwood (*Ostrya virginiana*). The ground layer is dominated by seedling Sugar Maple and White Ash with Northern Maidenhair Fern (*Adiantum pedatum*), Rattlesnake Fern (*Botrychium virginianum*), White and Red Baneberries (*Actaea pachypoda, A. rubra*), Spinulose, Glandular and Marginal Wood Ferns (*Dryopteris carthusiana, D. intermedia, D. marginalis*), White Trillium (*Trillium grandiflorum*), Wild Ginger (*Asarum canadense*), Lopseed (*Phryma leptostachya*), Melic Grass (*Melica smithii*), Sweet Cicely (*Osmorhiza claytonii*), Hemp-nettle (*Galeopsis tetrahit*) and Herb Robert (*Geranium robertianum*).

Significant Species of Deciduous Forest (1)

Melic Grass (*Melica smithii*) grows in the Butternut – Sugar Maple – Large-toothed Aspen stand (1E) near the north end of the park. Melic Grass is a species that is restricted geographically in Central Region (Riley 1989). It is a disjunct species with the main centre of its distribution in western or cordilleran North America.

The following species are found at only one or two locations in the park and are therefore considered locally significant. The only stand of Christmas Fern (*Polystichum acrostichoides*) in the park, a population estimated at 60 to 70 plants, occurs in Sugar Maple – Beech forest (1A). Juneberry (*Amelanchier spicata* var. *spicata*) is a shrub in the deciduous forests along the western edge of the north and south outliers (community 1D). Cutleaf Toothwort (*Dentaria laciniata*) grows at one location only, in a deciduous woodlot above the escarpment. A small stand of Dwarf Scouring-rush (*Equisetum scirpoides*) dots the banks of Sheldon Creek near a small waterfall, the contact between Manitoulin dolostone and Whirlpool sandstone. Hobblebush (*Viburnum alnifolium*) was observed at only one location in the park, at the edge of deciduous forest and an old field community. Dutchman's-breeches (*Dicentra cucullaria*) was observed at only two locations in the park, in deciduous forest behind the escarpment rim (1A) and on a shaded cliff (4B). Further spring fieldwork may reveal other stands of this spring ephemeral.

Three other species of interest found in the deciduous forests of the park are Leatherwood (*Dirca palustris*), Spotted Coral-root (*Corollarhiza maculata*), a saprophytic orchid, and Common Juniper (*Juniperus communis*), one plant of which was observed in community 1D.

2 MIXED FOREST

The distribution of mixed forest in the park shows up very clearly on aerial photography at 1:20,000 scale, taken in the spring or fall of 1988, when deciduous trees were leafless. This photography was used, in conjunction with field work and interpretation of 1978 aerial photography (1:10,000 scale), to delineate the boundaries of the mixed forest communities.

There is a concentration of mixed forest at the south end of the park, in the south outlier valley, along some slopes of the south outlier and on the plateau of the south outlier. The almost continuous deciduous forests on the moraine uplands west of the escarpment are broken by mixed forest lining the steep slopes along the eastern shore of McCarston's Lake. North of Jacob's Ladder on the second line, there is an indentation in the escarpment where the stream flows out of McCarston's Lake. Mixed forest covers the mantled escarpment slopes here, south of the mixed swamp found along the stream. Mixed forest also borders some sections of stream courses, for example north and south of the beaver pond at UTM 740775. Small mixed forest stands occur in other locations scattered about the park. Some of these are shown on Map 1, Vegetation, but often these inclusions were mapped as part of the prevalent vegetation type.

In general, mixed forest was found on dry mesic to mesic sites on the moraine and spillway and on mantled escarpment slopes, and wet mesic to mesic sites adjacent to mixed swamp communities and beside stream courses. Mixed forest occupies approximately 449 ha or 6.1 percent of the total park area. The stands surveyed were grouped into five community types, which are described below. The microclimate of these stands was classed as either normal or colder-than-normal in situations on slopes with north or east-facing aspects or sites adjacent to cool, spring-fed swamps.

2A White Cedar – White Birch

Several stands dominated by White Cedar and White Birch were found on dry mesic to dry sand, loam and clay sites. Forests composed of White Cedar (15 to 51 cm d.b.h.), White Birch (to 25 cm d.b.h.), with Eastern Hemlock and occasional Sugar Maple grow on the eastern side of McCarston's Lake, covering the steep to moderate, sandy slopes rising from the kettle lake. White Cedar dominates the forest along the western edge of the plateau of the south outlier near UTM 748760, in a band extending back from the rim. Species forming various associations with White Cedar are White Birch, Balsam Poplar, Eastern Hemlock, White Spruce, Large-toothed Aspen and Balsam Fir. Tree size ranges from 15 to 36 cm d.b.h. It is possible that some of the White Spruce at this location were planted. Interspersed amongst the closed mixed forest (estimated at 90 percent closure) are openings consisting of Poverty Oat Grass (*Danthonia spicata*), Eastern Bracken (*Pteridium aquilinum*) meadow, regenerating with deciduous species such as Trembling Aspen, White Ash, Black Cherry and Sugar Maple.

Several wet mesic to mesic sites, along stream courses or adjacent to swamp communities, also support mixed forest stands dominated by White Cedar and White Birch. Associated trees are Eastern Hemlock and Yellow Birch with some White Elm, Red Maple, Sugar Maple, Ironwood and White Spruce. Tree sizes range from sapling to 30 cm d.b.h. with scattered trees of larger d.b.h. present (*e.g.* 50 cm d.b.h.). Degree of canopy closure was estimated as 80 percent. Understorey species including the following shrubs and saplings: Mountain Maple (*Acer spicatum*), Canada Yew (*Taxus canadensis*), Fly-honeysuckle (*Lonicera canadensis*), Alternate-leaved Dogwood (*Cornus alternifolia*), and Balsam Fir (*Abies balsanea*). The ground cover, which is about 75 percent continuous, consists of herb and fern species such as: Wild Lily-of-the-valley (*Maianthemum canadense*), Purple

Trillium (*Trillium erectum*), Bluebead-lily (*Clintonia borealis*), Solomon's-seal (*Polygonatum pubescens*), Gold-thread (*Coptis trifolia*), Foam Flower (*Tiarella cordifolia*), Wood-sorrel (*Oxalis montana*), Sweet-scented Bedstraw (*Galium triflorum*), Smooth White Violet (*Viola pallens*), Great spurred Violet (*Viola selkirkii*), Northern Beech Fern (*Phegopteris connectilis*), Spinulose Wood Fern (*Dryopteris carthusiana*), and Oak Fern (*Gymnocarpium dryopteris*).

2B White Birch – Trembling Aspen – White Cedar

In the south outlier valley, south of "the Pines" (community 13A), and north of the large mixed swamp (community 6C), is an area of mixed forest composed of White Birch, Trembling Aspen and White Cedar sited on mesic, sandy soils. Trees reach 36 cm d.b.h. Red Pine and occasional White Spruce and White Pine line both sides of the sandy road up the valley, which is now the main Bruce Trail, and extend back into the stand. These conifers were probably planted at the same time as the Red Pine and White Pine in "the Pines" (community 13A).

2C Sugar Maple – Eastern Hemlock – White Cedar

This general community type encompasses a variety of stands found on mantled escarpment slopes in three locations in the park: 1) the lower slopes of the south outlier in the south outlier valley; 2) the forested slopes north of Jacob's Ladder on the second line, but south of the mixed swamp (community 6B) in the lowland along the stream flowing out of McCarston's Lake; and 3) the clay slopes just west of the mixed swamp (community 6D); along the third line. Many different slope aspects are found within this unit; west, northwest and north-facing, east-facing and south-facing. Low outcrops of escarpment bedrock occur along sections of these slopes, and limestone boulders are common. Stands within this community type are composed of various combinations of Sugar Maple, Eastern Hemlock, White Cedar, White Birch and Yellow Birch. In these stands species such as Red Maple, Beech, Basswood, White Ash, Black Cherry and Large-toothed Aspen also occur. The age of these forests is variable. Generally, scattered larger trees occur (to 60 cm d.b.h.), with frequent saplings and younger trees (to 30 cm d.b.h.).

2D Sugar Maple – White Birch – Large-toothed Aspen – Eastern Hemlock

Mixed forest occupies valley bottom sites in the north half of the south outlier valley. It surrounds the mixed swamp (6C) along the stream course that flows north from the spring located at UTM 747765, into Sheldon Creek. The composition of these mixed forests is variable. Different combinations of the following tree species occur: Sugar Maple, White Birch, Large-toothed Aspen, Eastern Hemlock, American Beech, Butternut, Black Cherry, Red Maple, White Ash and Trembling Aspen. Tree sizes range from sapling to 38 cm d.b.h. The site is fine sandy loam and mesic.

2E Red Maple – Black Cherry – Eastern Hemlock

Another mixed forest type is dominated by Red Maple, with Black Cherry and Eastern Hemlock subdominant. Other tree species present include Sugar Maple, White Ash, White Cedar, American Beech and White Birch. In the autumn, the light emanating from the reds, oranges and yellows of the deciduous trees in the canopy and the leaves on the forest floor contrasts beautifully with the darker green tones of the conifers. This stand is located in the south outlier valley on a very gently sloping, fine sandy loam, mesic site, between the mixed swamp community (6C) and the main Bruce Trail. Tree size ranges from sapling to 36 cm d.b.h., with an occasional larger tree (46 cm d.b.h.). Canopy closure was estimated at 85 percent. The understorey consists of sapling trees and shrubs such as Red Maple, White Ash, Black Cherry, Balsam Fir, Sugar Maple and Alternate-leaved Dogwood (*Cornus alternifolia*) and Mountain Maple (*Acer spicatum*). In places there is a dense understorey of Canada Yew (*Taxus canadensis*). The ground layer includes seedlings of the tree species listed above and the following herbs: sedge (*Carex pedunculata*), Bluebead-lily (*Clintonia borealis*), Gold-thread (*Coptis trifolia*), Solomon's-seal (*Polygonatum pubescens*), Wild Lily-of-the-valley (*Maianthemum canadense*), Purple Trillium (*Trillium erectum*), Downy Yellow Violet and Great-spurred Violet (*Viola pubescens, V. selkirkii*), Rose Twisted Stalk (*Streptosus roseus*) and Star-flower (*Trientalis borealis*). Three species of clubmoss and three species of fern were noted: Running Clubmoss (*Lycopodium clavatum*), Shining Clubmoss (*Lycopodium lucidulum*), Ground-pine (*Lycopodium obscurum*), Glandular Wood Fern (*Dryopteris intermedia*), Marginal Wood Fern (*Dryopteris marginalis*), and Oak Fern (*Gymnocarpium dryopteris*).

2F Sugar Maple – Eastern Hemlock – White Ash – American Beech

A woodlot on top of the south outlier, near its south end, supports a mixed age forest composed of Sugar Maple, Eastern Hemlock, White Ash, American Beech, Black Cherry and White Birch, ranging from sapling to 61 cm d.b.h. in size. Cuddy (1973b, p. 68) noted that the woodlot was recently logged and lightly grazed.

PRIMARY – ESCARPMENT

The exposure of the main face of the Niagara Escarpment and two dolostone outliers within the park is one of its outstanding geological, biological and scenic features. In this region, the Niagara Escarpment is largely buried by moraine and outwash deposits. Three major community types are associated with limestone bedrock habitats exposed along the escarpment and its outliers: 3) Bedrock Pavement Rim, 4) Cliffs and 5) Talus and Steep Bedrock Slopes. Sites classed as primary escarpment sites have either no soil or very thin overburden, no greater than 15 cm in depth, over rock. Escarpment communities occupy approximately 57.4 ha or 7.8 percent of the park.

3 BEDROCK PAVEMENT RIM

The locations where Bedrock Pavement Rim communities are best developed in the park are mapped on Map 1, Vegetation. Typically a forest of White Cedar extends back from the edge of the Niagara Escarpment cliff in a narrow band, from less than 1 m in width to 10 m in width. White Cedar rim forest also grows on top of dolostone limestone blocks separated from the main escarpment in areas where cliff-face fissure systems are developed.

A White Cedar cliff-edge community is distinctive of the Niagara Escarpment along its length. Trees associated with the White Cedar rim include White Birch and occasional Basswood, Ironwood, Yellow Birch, Eastern Hemlock, Sugar Maple, Red Maple and Large-toothed Aspen. In some locations, tall clumps of Mountain Maple (*Acer spicatum*) grow in openings between trees forming a tall shrub layer 3.7 to 4.6 m high. The composition, structure and age of forests growing on bedrock pavement rim sites varies at different locations in the park. In general, tree sizes range from sapling to 36 cm d.b.h. White Cedar with notably larger diameters occur at several locations. Tree height was estimated at 12 to 24 m. Degree of canopy closure ranged from 60 to 90 percent.

The ground cover in this community is sparse. Much of the ground is bare, with leaf litter only. About 30 percent is covered with the following herbs: Wild Lily-of-the-valley (*Maianthemum canadense*), Wild Sarsaparilla (*Aralia nudicaulis*), Sedge (*Carex eburnea*), Rock Polypody (*Polypodium vulgare*), Maidenhair Spleenwort (*Asplenium trichomanes*), Marginal and Glandular Wood Ferns (*Dryopteris marginalis*, *D. intermedia*), Eastern Bracken (*Pteridium aquilinum*), Solomon's-seal (*Polygonatum pubescens*), False Solomon's-seal (*Smilacina racemosa*), Small-flowered Buttercup (*Ranunculus abortivus*), and Motherwort (*Leonurus cardiaca*). Shrubs found occasionally in this community include: Canada Yew (*Taxus canadensis*), Swamp Black Currant (*Ribes lacustre*), Maple-leaved Viburnum (*Viburnum acerifolium*) and Bush-honeysuckle (*Diervilla lonicera*).

Soil moisture conditions were classed as dry to very dry. Microclimate could be classed as normal, colder-than-normal, or warmer-than-normal, because these sites are very exposed to seasonal environmental fluctuations. In two locations, this community occupies a broader band, up to 30 m wide, growing on steep slopes rising up from the escarpment rim or from cliff-face fissure systems. In other locations, the bedrock pavement rim community grades quickly into deciduous forest or old field communities. In some locations it occupies such a small area or such a narrow band at the cliff-edge that it could not be mapped.

The White Cedar cliff-edge forest has been studied by Larson (1989, 1990), Larson *et al.* (1989), Bartlett *et al.* (1990) and Mattes-Sears and Larson (1990), as part of research into cliff-edge and cliff-face forests associated with exposed cliffs along the Niagara Escarpment. Larson *et al.* (1989) studied a transect across the cliff gradient that extended 10 m into the forested plateau on top of the cliff and 10 m into the talus at the base of the cliff. In discussing the forested plateau above the cliff, Larson *et al.* (1989, p. 2740) notes that "The transition from dense deciduous forest canopy to broken coniferous canopy is exceptionally compressed ... At the cliff edge and across the cliff face, soil depths are near zero except in small pockets and ledges that accumulate litter ... and the plant community is fully exposed to environmental fluctuations."

Bartlett *et al.* (1990, p. 1931, 1939) studied 13 components of the physical environment of cliff-edge forests along the Niagara Escarpment as compared with adjacent deciduous forests on the plateau. The results of this study "... indicate a strong environmental gradient between the cliff edge and deciduous forests habitats. Lower and more rapidly fluctuating soil moisture levels combined with low photosynthetically active radiation at the cliff edge suggest that conditions there are frequently more severe for plants than in the deciduous forest in summer. ... During the winter, there were prolonged periods of low air and soil temperatures in the cliff-edge zone because of the lack of protective snow cover and this, combined with high wind speeds, could be detrimental to plants at the cliff edge."

Larson (1990) studied the effects of hiking and climbing disturbance in the old growth White Cedar forests at the cliff edge. He compared eight disturbed transects and eight undisturbed transects. One effect observed was the almost total absence of seedlings in the disturbed areas. Larson concluded, "The disturbed parts of the cliff-edge ecosystem are therefore not self-sustaining, and this has considerable significance in view of the great age shown by many of the trees." There is further discussion of ecological research into the slow-growing, long-lived forests of White Cedar along the cliff-edge and cliff-face of the Niagara Escarpment in section 4A.

Included within community 3 on Map 1, is the Niagara Escarpment rim slope stand sampled by Varga in 1981, as part of a quantitative study of the forests of the Niagara Escarpment (Varga pers. comm.). This stand, near the northwestern tip of the south outlier, at UTM 747769, is described by Varga as "... an evergreen-deciduous, intermediate-aged forest of Paper Birch and Eastern Hemlock with a scattering of Red Maple, Large-toothed Aspen, Eastern White Cedar, Sugar Maple and Beech ... The stand occurs in a large semi-circular hollow ... on either side along the rim it grades into a Cedar-Birch rim forest." All the other stands placed in the bedrock pavement rim unit are dominated by White Cedar. This stand appears to be intermediate between the White Cedar – White Birch forest at the escarpment rim, and the deciduous forests on the plateau of the south outlier to the east, in both its site and composition.

Significant Species of Bedrock Pavement Rim (3)

Species restricted to escarpment-related habitats (bedrock pavement rim, cliffs, talus slope) in the park were considered locally significant, although certain of these species grow abundantly where suitable habitat occurs. Maidenhair Spleenwort (***Asplenium trichomanes***) and Rock Polypody (***Polypodium virginianum***) are locally significant species associated with the Bedrock Pavement Rim community.

4 CLIFFS

Vertical cliffs of Amabel dolostone, ranging from 3 m to 30 m in height define the Niagara Escarpment as it crosses the park in a north-south direction. Cliffs encircle most of the north outlier and the west, north and northeast sides of the south outlier. Cliffs are mapped on Map 1, Vegetation. In total, over 6 km of cliffs occur within the park. The cliffs are aligned in all directions of the compass, from east-facing to south-facing. All aspects of slope exposure exist, and all three microclimatic regimes were considered to occur as well.

High cliffs (greater than 10 m) and low cliffs (greater than 3 m and less than 10 m) are described separately in this chapter because of differences in vegetation and site conditions. The cliffs along the main escarpment from north of Mono Centre to the Jacob's Ladder area have been mapped in detail, and have been differentiated into two height categories: A) Cliffs greater than 10 m, and B) Cliffs greater than 3 m but less than 10 m.

Detailed and precise mapping of the cliff-face from Mono Centre to Jacob's Ladder was accomplished by walking the cliff-edge and following the cliff-base near the top of the talus slope along this stretch of the escarpment in the spring of 1990, before the deciduous leaves were unfurled. The remainder of the cliffs in the park have been mapped in a more general way, from notes made during fieldwork in 1989 and 1990, and from map and airphoto interpretation. These cliffs could be mapped in greater detail sometime in the future.

In some locations, a very low cliff or rock outcrop (1 to 3 m in height) marks the top of the escarpment slope, or there is a break in the cliff and no rock outcrop occurs at all. Certain of these breaks in the cliff have been used as access routes up and down the escarpment, farmtracks or roads, such as the Carriage Trail, or the 2nd line where crosses the escarpment. Sometimes these breaks are used as animal trails, especially by White-tailed Deer, or as unofficial hiking trails.

4A Cliffs Greater than 10 m

Reaching 30 m in height or more, the vertical, bare, rock-faces of the higher cliffs in the park are exposed to sun, wind, and extremes of temperature, both high and low. The cliffs are highly stressed environments, offering very dry to arid conditions for plant growth. Small amounts of soil accumulate in cracks and small pocket depressions, and on rock ledges on the cliffs. In these microhabitats, mats of moss accumulate and other vegetation sets its roots.

A sparse forest of White Cedar mixed with some White Birch grows on the exposed cliff-face. Larson (1989 and 1990) and Larson *et al.* (1989) have studied this cliff-face and cliff-edge forest at Mono Cliffs, and at sites along the length of the Niagara Escarpment. Through measurements of tree diameter, height, and tree coring and aging of samples of White Cedar growing on the cliff-face and cliff-edge, Larson has discovered that the trees average 100 to 120 years in age. "Some cliff-face cedars only 30 cm high and less than 3 cm in diameter show 155 annual rings." (Larson pers. comm.). The presence of some larger trees (up to 12 cm in diameter and 5 m tall), that are greater than 600 years old suggests that the cliff-face and cliff-edge forests along the length of the Niagara Escarpment are some of the oldest, most intact, old growth forests in eastern North America. Aging of dead stumps found on the talus below the cliffs determined that trees greater than 1000 years in age may have existed in recent history. Because of the small, stunted size of many of the trees and the inaccessibility of the cliff habitat, these cliff-face and cliff-edge forests have escaped the widespread logging of upland forests that occurred with the settlement of southern Ontario in the last half of the 19th century and into the early 1900's.

At Mono Cliffs, Larson (1989) sampled five sections of exposed cliff face which were selected randomly from the extent of continuous exposed cliff-face available. A line was established, beginning 0.5 m back from the cliff edge and extending down the cliff to its base at the top of the talus. All the stems of white Cedar in a 6 m band along this line were sampled. The following data were recorded: a sketch of the tree and a description of its location, height or length (m), diameter (cm) at coring level, coring height, and information on morphology or habitat. Trees greater than 2.5 cm were cored with an increment borer, while smaller stems were cut.

The results of Larson's study of cliff-edge and cliff-face forests at Mono Cliffs show an age-class distribution pattern that follows that expected for undisturbed, old growth forests. The majority of the stems sampled were under 200 years old. There was a lower number of trees with ages ranging between 200 and 440 years (Larson 1989, p. 16-18). Trees greater than 300 years of age were found on three transects. One tree sampled was 428 years in age and several were in the 350 to 400 year range (Larson pers. comm.). All transects had seedlings.

In addition to the sparse forest of White Cedar scattered on the exposed cliffs, there are lichens and mosses growing on bare rock faces, and rock ferns, herbs and shrubs in cracks and on ledges. White Ash and Sugar Maple are other trees that occasionally occur with the White Cedar and White Birch typically found on the cliffs. Smooth Cliff-brake (*Pellaea glabella*), Maidenhair Spleenwort (*Asplenium trichomanes*), Bulbet Fern and Fragile Fern (*Cystopteris bulbifera, C. fragilis*) are typical species of the exposed dolostone cliffs. These ferns also grow on small ledges on the cliffs where mosses and small amounts of soil accumulate. Other species observed in this microhabitat include: Rock-cress (*Arabis hirsuta*), Pussytoes (*Antennaria neglecta*), Poverty Oat Grass (*Danthonia spicata*), Canada Blue Grass (*Poa compressa*), sedge (*Carex eburnea*), Catnip (*Nepeta cataria*), Motherwort (*Leonurus cardiaca*), Dogmint (*Satureja vulgaris*), Herb Robert (*Geranium robertianum*) and Gray Goldenrod (*Solidago nemoralis*). Shrubs rooted on ledges and in cracks on the cliffs include Round-leaved Dogwood (*Cornus rugosa*), Bush-honeysuckle (*Diervilla lonicera*) and Red-berried Elder (*Sambucus pubens*).

4B Cliffs Greater than 3 m and Less than 10 m

Some of the cliffs in the park are greater than 3 m, but less than 10 m in height. These low cliffs are often shaded by the canopy of the mixed or deciduous forests on the talus or mantled slope below. Low cliffs tend to offer a more protected, shaded, moister environment than higher, exposed cliffs, and are discussed here separately for this reason. Of course, the features of low and high cliffs described separately here in text, intergrade in various ways in the field.

White Cedar dominates these low cliffs with occasional White Birch and Yellow Birch. Species observed on low cliffs include the following: lichens and mosses, Bishop's Cap (*Mitella diphylla*), Columbine (*Aquilegia canadensis*), Bulbet Fern (*Cystopteris bulbifera*), Smooth Cliff-brake (*Pellaea glabella*), Rock Polypody (*Polypodium vulgare*), Marginal Wood Fern (*Dryopteris marginalis*), Rock-cress (*Arabis hirsuta*), Dutchman's-breeches (*Dicentra cucullaria*), Jewelweed (*Impatiens* sp.), Herb Robert (*Geranium robertianum*), Canada Blue Grass (*Poa compressa*), Butter-and-eggs (*Linaria vulgaris*), Yarrow (*Achillea millefolium*), Dandelion (*Taraxacum officinale*), Canada Gooseberry (*Ribes hirtellum*), Mountain Maple (*Acer spicatum*) and Red-berried Elder (*Sambucus pubens*).

4C Cliff-face Fissure Systems

Block fracture and fissure systems are well-developed at eight locations along the cliff-faces within the park. These fissure systems provide a cool, moist, shaded environment which shelters a distinctive community of mosses, lichens, liverworts, ferns and associated species.

These fissures illustrate the processes maintaining the escarpment as a vertical cliff-face. Underlying the Amabel dolostone cliffs of the escarpment is softer, Cabot Head shale. As this shale erodes, the overlying dolostone becomes destabilized. Blocks of dolostone may break off the cliff-face and drop to the talus slope below. Blocks of dolostone also lean away from the escarpment face forming narrow fissures. Over time these fissures may widen and deepen. Frequently two long, outlying blocks of dolostone separated by two long, fissures or ravines may be present in a cliff-face fissure system, and sometimes a series of three fissures may be present. These fissures may be 2 to 8 m wide and 2 to 20 m deep. Ice and snow persist in the deeper, shaded fissures until summer. For the purposes of the Vegetation Matrix (Figure 3), the special microenvironment within these cliff-face fissure systems has been classed as wet mesic to dry mesic with a colder-than-normal microclimate.

The cliff-face fissure systems within the park have developed in zones along the escarpment where springs rise, further downslope, at the contact between the Amabel dolostone and Cabot Head Shale. They have also developed in areas that may have been undermined by meltwater spillways for example, on the east sides of the north and south outliers. The presence of water in the bedrock of these zones at present, or in the geological past, could possibly be considered a causative factor in the creation of the fissure systems.

White Cedar, Yellow Birch, White Birch and Mountain Maple (*Acer spicatum*) grow in cracks and on ledges of the cliff-faces in the fissure systems and overhang the crevices providing shade. The trees of White Cedar and Birch average 15 to 25 cm d.b.h., but in some locations reach 61 cm d.b.h. or greater. The plants growing on the cliff-faces include Maidenhair Spleenwort (*Asplenium trichomanes*), Rock Polypody (*Polypodium vulgare*), Bulbet Fern (*Cystopteris bulbifera*), Walking Fern (*Camptosorus rhizophyllus*), Slender Cliff-brake (*Cryptogramma stelleri*), Bishop's Cap (*Mitella diphylla*), Kidney-leaved Violet (*Viola renifolia*), Small Enchanters' Nightshade (*Circaea alpina*), Sweet-scented Bedstraw (*Galium triflorum*), Spikenard (*Aralia racemosa*), Wild Columbine (*Aquilegia canadensis*), Herb Robert (*Geranium robertianum*) and Jewelweed (*Impatiens* sp.).

When undisturbed, the floor at the base of the crevices holds an accumulation of loose, loamy soil mixed with leaf litter and organic matter. The floor is covered with a lush growth of ferns and herbs of the following species: Marginal and Glandular Wood Fern (*Dryopteris marginalis, D. intermedia*), Bulbet Fern (*Cystopteris bulbifera*), Spikenard (*Aralia racemosa*), Jack-in-the-Pulpit (*Arisaema triphyllum*), Naked Mitrewort (*Mitella nuda*), and Jewelweed (*Impatiens* sp.). A collection of the bryophytes in one crevice, made by J. L. Riley and K. M. Lindsay on 30 September 1989, yielded the following species: *Anomodon rostratus, Anomodon viticulosus, Brachythecium rutabulum, Conocephalum conicum, Lepraria* cf. *finkii, Mnium ambiguum, Plagiomnium cuspidatum, Porella platyphylla*, and *Taxiphyllum deplanatum*. These bryophytes were identified by R. R. Ireland, P. Y. Wong and L. M. Ley at the National Museum of Natural Sciences (CAN).

The locations of the cliff-face fissure systems are on file at the Southern Region office of the Ministry of Natural Resources, Aurora. They are not shown on Map 1, Vegetation. These systems are sensitive to very low levels of visitation. Even small amounts of foot traffic can destroy the mats of mosses, liverworts and ferns growing on the moist, rock faces and compact the loose, loamy-organic soil on the crevice floors. In the 18 years since the first ecological assessment of the park and the author's first field studies there (Cuddy 1973, Lindsay 1973), three of the best developed cliff-face fissure systems have deteriorated from a high level of visitation and overuse. In the section on Management Considerations, Chapter III (vi), measures designed to allow the recovery and regeneration of these systems are suggested.

Significant Species of the Cliffs (4)

A very small population of Green Spleenwort (*Asplenium viride*), a regionally rare species, grows in one location in the park. Six plants were counted in 1989 in its cliff-face fissure habitat (community 4C). In 1974, this plant was somewhat more abundant at this location; however, visitation and overuse have effected the vegetation of this cliff-face fissure system and this population adversely. The regionally rare Rock-cress (*Arabis hirsuta*) was observed growing on cliffs in the south outlier valley.

Walking Fern (*Camptosorus rhizophyllous*) is a species that is restricted geographically in Central Region to limestone bedrock habitats along the Niagara Escarpment and elsewhere only along limestone river cliffs such as at Elora (Riley 1989). A number of other species are also restricted to escarpment-related habitats (bedrock pavement rim, cliffs, talus slope) in the park. These plants are considered locally significant, although certain of these species grow abundantly where suitable bedrock habitat occurs: Maidenhair Spleenwort (*Asplenium trichomanes*), Slender Cliff-brake (*Cryptogramma stelleri*), Smooth Cliff-brake (*Pellaea glabella*), and Rock Polypody (*Polypodium vulgare*). Dutchman's-breeches (*Dicentra cucullaria*) is also considered locally significant because it was observed at only two locations in the park, on a shaded cliff (4B) and in deciduous forest behind the escarpment rim (1A). Further spring fieldwork may reveal other stands of this spring ephemeral.

5 TALUS AND STEEP BEDROCK SLOPES

Below the cliffs of the Niagara Escarpment and its outliers are steep talus slopes covered by an accumulation of moss-covered dolostone boulders and bigger dolostone blocks. Mixed and deciduous talus forests reach down these slopes from the base of the cliffs to the spillway plain below. These distinctive talus forest communities are found only along the Niagara Escarpment in southern Ontario. At Mono Cliffs, excellent examples of talus communities skirt the escarpment and its two outliers for over 8 km.

The steep talus slopes vary in terms of their length, the angle of the slope and the size of the loose rock material (*e.g.* boulder, scree, blocks) forming the talus. The talus slopes, with the largest blocks and boulders, are associated with sections along the escarpment and outliers with high cliffs or with well-developed cliff-face fissure systems. Leaf litter and organic soil fills the crevices between the moss-covered limestone boulders and blocks. Seepage areas and springs rise along the talus slopes in the zone of contact between the Amabel dolostone and the underlying, impervious Cabot Head shale. Seepage areas and springs rise along the main escarpment face south from the incised valley to Mono Centre, and at the north end of the north outlier. Site moisture conditions vary from dry mesic to mesic to wet mesic. Due to the range of slope exposures, all microclimatic regimes were considered to occur. Included within this unit are the bedrock-controlled slopes on the east side of the park, which descend from the Manitoulin terrace and which are underlain by Queenston shale. These slopes are dotted with frequent, smaller boulders.

The vegetation communities observed on the talus slopes of the park have been grouped into four major types; two dominated by mixed forest and two dominated by deciduous forest. There is considerable variation within these four major types. They are mapped on Map 1, Vegetation and are described below. Please note that Map 1, Vegetation does not portray the areal extent of the talus communities accurately, because it is drawn from an uncorrected airphoto mosaic, and these are steeply sloping sites.

5A White Cedar – White Birch

A mixed talus forest composed of White Cedar and White Birch, with occasional Yellow Birch, blankets talus slopes in six locations in the park: i) along the main escarpment north from Mono Centre for 600 m to UTM 745759; ii) below the Jacob's Ladder area at UTM 739774; iii) on slopes beneath escarpment cliffs just north of the incised valley leading to McCarston's Lake at UTM 738779; iv) along the main escarpment at the north end of the park near the 25th sideroad; v) on east-facing slopes of the north outlier; vi) and on west-facing slopes of the south outlier and on its northern tip and northeast side. White Birch dominates over White Cedar at some sites. Evidence of past fire was noted on most of the talus slopes where White Birch was dominant. Small stands of more mature forest dominated by Yellow Birch (25 to 50 cm d.b.h.) are included within this unit. White Cedar in association with White Birch, Basswood, Hemlock and Sugar Maple (to 30 cm d.b.h.) forests grows on the talus slopes along the main escarpment north from Mono Centre to UTM 745759.

In general, tree size ranges from 18 to 25 m in height, and d.b.h. ranges from sapling to 30 cm. Estimates of degree of canopy closure vary widely between 40 and 90 percent. Where the canopy is more open, tall thickets of Mountain Maple (*Acer spicatum*) and Alternate-leaved Dogwood (*Cornus alternifolia*), reaching 11 m in height, cover the slope. Canopy openings occur where older trees have fallen, or in situations where slope conditions may be relatively unstable.

Understorey species observed on these White Cedar – White Birch talus slopes include tall Mountain Maple and Alternate-leaved Dogwood, sapling Balsam Fir, Ironwood, White Ash, and the shrubs, Canada Yew (*Taxus canadensis*), Fly-honeysuckle (*Lonicera canadensis*), and Swamp Black Currant (*Ribes lacustre*). Ferns and fern-allies of the following species grow abundantly on the moss-covered boulders of these talus slopes: Maidenhair Spleenwort (*Asplenium trichomanes*), Walking Fern (*Camptosorus rhizophyllous*), Rock Polypody (*Polypodium virginianum*), Marginal and Intermediate Wood Ferns (*Dryopteris marginalis, D. intermedia*), Bulbet and Fragile Ferns (*Cystopteris bulbifera, C. fragilis*), Rattlesnake Fern and Daisy-leaved Grape Fern (*Botrichium virginianum* and *B. matricarifolium*), Oak Fern (*Gymnocarpium dryopteris*) and Shining Clubmoss (*Lycopodium lucidulum*). Four moss species were collected from this habitat by J. L. Riley and K. M. Lindsay on 30 September 1989: *Anomodon attenuatus, Brachythecium salebrosum, Plagiomnium cuspidatum, Rhodobryum ontariense*. These bryophytes were identified by R. R. Ireland, P. V. Wong and L. M. Ley at the National Museum of Natural Sciences (CAN).

Herbaceous plants of the following species also formed part of the ground cover: Wild Sarsaparilla and Spikenard (*Aralia nudicaulis, A. racemosa*), Naked Mitrewort and Bishop's Cap (*Mitella nuda, M. diphylla*), Wild Lily-of-the-valley (*Maianthemum canadense*), Enchanter's Nightshade (*Circaea alpina, C. lutetiana*), Sweet-scented Bedstraw (*Galium triflorum*), Kidney-leaved Violet (*Viola renifolia*), False Solomon's seal (*Smilacina racemosa*), Blue Cohosh (*Caulophyllum thalictroides*), Wild Ginger (*Asarum canadense*), Jack-in-the-pulpit (*Arisaema triphyllum*), Dwarf Raspberry (*Rubus pubescens*), Herb Robert (*Geranium robertianum*), Jewelweed (*Impatiens pallida*), and Helleborine (*Epipactis helleborine*).

5B White Birch – White Ash – White Cedar – Sugar Maple

The west and south-facing slopes of the north outlier support a successional forest of White Birch and White Ash with White Cedar, Sugar Maple and Large-toothed Aspen and occasional Eastern Hemlock, Basswood and

Ironwood. The trees range from sapling to 48 cm d.b.h. and are approximately 25 m high. The site is a dry mesic, steep, bedrock slope with frequent limestone boulders and a warmer-than-normal microclimate. A burnt stump (35 cm d.b.h.) and fallen tree provide evidence of a fire in the past. The understorey species are similar to those described for community 5A, with a few species of drier sites also present, for example, Round-leaved Dogwood (*Cornus rugosa*), Bush-honeysuckle (*Diervilla lonicera*), Rough-leaved Mountain-rice (*Oryzopsis asperifolia*), and Sedge (*Carex eburnea*).

5C Sugar Maple – Butternut – Basswood – Yellow Birch

The talus slopes along the main escarpment from UTM 745759 north to the Jacob's Ladder area are forested with Sugar Maple, Butternut, Basswood and Yellow Birch, with trees from sapling to 60 cm d.b.h. Associated trees include White Ash, White Birch and Ironwood. Closed canopy stands dominated by Sugar Maple alternate with sections of more open, steep, bouldery talus characterized by Butternut, Basswood and Yellow Birch. Varga (pers. comm.) notes that these open Butternut – Basswood talus forests are significant as they are known elsewhere along the escarpment only from Rattlesnake Point and Mount Nemo. In some locations, occasional trees of White Cedar grow along the base of the talus slope. The sites on these talus slopes were classed as mesic to wet mesic, with a normal microclimate.

Along these talus slopes, Mountain Maple (*Acer spicatum*) and Alternate-leaved Dogwood (*Cornus alternifolia*) also form a tall shrub layer in the understorey, reaching 11 m in height. This understorey layer varies from sparse to dense, depending on the openness of the overstorey. In some locations, it may be the dominant cover. Ground layer species observed in this community included many of those recorded for communities 5A and 5B, and the following additional ones: Northern Maidenhair Fern (*Adiantum pedatum*), Red-berried Elder (*Sambucus pubens*), and spring wild flowers such as, Squirrel Corn (*Dicentra canadensis*), Solomon's-seal (*Polygonatum pubescens*), Small-flowered Buttercup (*Ranunculus abortivus*), Virginia Waterleaf (*Hydrophyllum virginianum*), Common and Purple Trilliums (*Trillium grandiflorum, T. erectum*), and Toothwort (*Dentaria diphylla*).

5D Sugar Maple – White Ash

Another community type found on escarpment slopes with mineral soils and frequent moss-covered boulders is deciduous forest dominated by Sugar Maple with White Ash, White Birch, Basswood, Beech, Ironwood and Large-toothed Aspen. This community type occurs along the main escarpment at the north end of the park, at the southeast corner of the north outlier, along the east side of the south outlier and on the bedrock-controlled slopes which descend from the Manitoulin terrace at the base of the south outlier. These locations were considered to have a normal or colder-than-normal microclimate and mesic to wet mesic substrate conditions. Sometimes this community occupies the footslope at the base of a longer escarpment slope. These situations, where they adjoin old fields and pasturelands, are usually not fenced and were almost certainly grazed in the past.

Significant Species of Talus and Steep Bedrock Slopes (5)

The deciduous talus slopes of the main escarpment face (communities 5C and 5D) support populations of Hart's Tongue Fern (*Phyllitis scolopendrium*), a nationally, provincially and regionally rare species, which has a distribution restricted to the Niagara Escarpment in southern Ontario. Two plants of Ginseng (*Panax quinquefolius*) were observed at one location on the deciduous talus slopes (community 5D). This plant is a nationally and provincially rare species which has been designated as threatened by the Committee on the Status of Endangered Wildlife in Canada (White 1988). Cuddy (1973b, p. 56) observed the regionally rare Mountain-ash (*Sorbus americana*) on the mixed talus slope (5B) on the west side of the north outlier.

Holly Fern (*Polystichum lonchitis*) and Melic Grass (*Melica smithii*) are two species that are considered to be restricted geographically in Central Region, because they are disjuncts from western or cordilleran North America (Riley, 1989). Two plants of Holly Fern (*Polystichum lonchitis*) grow on mixed talus slopes (community 5A) at the north end of the park. Melic grass (*Melica smithii*) is found on deciduous slopes (community 5D) at the north end of the park. Walking Fern (*Camptosorus rhizophyllous*) is a species that is restricted geographically in Central Region to limestone habitats along the Niagara Escarpment and elsewhere along river cliffs such as at Elora (Riley 1989).

Two fern species of the talus slopes were considered to be locally significant because these species grow only in escarpment-related habitats in the park (bedrock pavement at the rim, cliffs, cliff-face fissure systems and talus slopes): Maidenhair Spleenwort (*Asplenium trichomanes*), and Rock Polypody (*Polypodium virginianum*). Another locally significant species of deciduous talus slopes is Canada Waterleaf (*Hydrophyllum canadense*).

PALUSTRINE – WETLAND

Wetlands make up 5 percent of the park area, or approximately 36.3 ha. Wetland types found in the park include: mixed swamp (24.1 ha), conifer swamp (6.5 ha), bog (0.1 ha) and marsh (5.6 ha).

6 MIXED SWAMP

"A swamp is ... a mineral wetland or a peatland with standing water or water gently flowing through pools or channels. The water table is usually at or near the surface. There is pronounced internal water movement from the margin or other mineral sources; hence the waters are rich in nutrients. If peat is present, it is mainly well-decomposed wood, underlain at times by sedge peat. The associated soils are Mesisols, Humisols and Gleysols. The vegetation is characterized by a dense cover of deciduous or coniferous trees or shrubs, herbs, and some mosses." (National Wetlands Working Group 1988, p. 423)

The six different mixed swamp communities observed at Mono Cliffs are described below and are mapped on Map 1, Vegetation. The soil moisture conditions of mixed swamp communities span a range from wet mesic to open water. All the swamps are fed by cold, groundwater discharge. The swamp forests and wetland areas below the escarpment are underlain by impervious shale bedrock of either the Cabot Head or Queenston formation, which blocks water drainage downwards. Soils are classed as organic. Microclimate was considered to be normal in some protected locations, such as community 6C. Other sites were classed as colder-than-normal because they were situated in depressions that could hold cold air drainage. The mixed swamp communities in the park cover approximately 24.1 ha in total.

6A Eastern Hemlock – Red Maple – Yellow Birch

Above the escarpment, mixed swamps dominated by Eastern Hemlock, Red Maple and Yellow Birch are found in several small kettle depressions of the moraine west of McCarston's Lake. Associated trees include White Spruce, White Birch, White Cedar, Balsam Poplar and Balsam Fir. The headwaters for the stream that flows into the west side of McCarston's Lake rise in these mixed swamps.

6B Red Maple – Black Ash – White Birch – White Cedar – Balsam Fir

Below the escarpment, closed to semi-open mixed swamp lines the floodplain of the stream flowing out of McCarston's Lake. Springs along the moraine slopes to the west and escarpment talus slopes to the north feed into this swamp. The cold, spring-fed stream that winds its way through the swamp, is about 30 to 60 cm wide and has very clear water and a sandy bottom.

A variety of associations and site moisture conditions are found within this swamp. Parts have a larger deciduous component than coniferous. Swamp forests composed of Red Maple, Black Ash, White Birch, Yellow Birch and White Cedar (sapling to 15 cm d.b.h.) occur. Along part of the stream floodplain, there is a closed forest cover of Balsam Poplar, White Cedar, Yellow Birch, Red Maple, White Birch and Black Ash (sapling to 30 cm d.b.h.). A wet mesic portion of the swamp is wooded with White Birch, in association with White Cedar, Balsam Fir and Balsam Poplar. The eastern section of the swamp is wetter, with saturated soil and many pools of standing water. A semi-open swamp community of White Birch, Balsam Fir, and White Cedar, with Red Maple, Larch and White Spruce characterizes this wetter section.

6C Yellow Birch – White Cedar – Eastern Hemlock – Balsam Fir – Black Ash

The south central part of the south outlier valley is filled by a large mixed swamp composed of Yellow Birch, White Cedar, Eastern Hemlock, Balsam Fir, Black Ash, and Red Maple (sapling to 36 cm d.b.h.). This mixed swamp is fed by a series of springs that rise at the base of the talus slopes along the main escarpment, on the west side of the valley. It forms the headwater area for the three ponds situated just north on Mono Centre. A stream flows south from these ponds to enter the Nottawasaga River in the Hockley Valley east of Glen Cross.

In the north half of the south outlier valley, mixed swamp of similar composition borders the spring-fed stream that rises and flows north. This spring-fed stream is one of several headwater sources for Sheldon Creek in the park. The mixed swamp forests along this headwater stretch help to maintain a coldwater stream habitat ideal for Brook Trout (*Salvelinus fontinalis*). Fry and fingerlings of Brook Trout have been observed along this branch of Sheldon Creek all the way upstream to its spring source at the concrete tile casing at UTM 746765 (Hood pers. comm.).

In communities 6A, 6B and 6C, understorey species provide up to 40 to 60 percent cover. Understorey species include Red-osier Dogwood (*Cornus stolonifera*), Mountain Maple (*Acer spicatum*), Canada Yew (*Taxus canadensis*) and saplings of canopy species such as White Cedar, Balsam Fir, Black Ash and Yellow Birch, which can reach 8 m in height. The ground layer of ferns, herbs, mosses and liverworts is very diverse and provides almost 100 percent cover. Typical species include: Shining Clubmoss (*Lycopodium lucidulum*), Spinulose, Crested and Marginal Wood Ferns (*Dryopteris carthusiana*, *D. cristata* and *D. marginalis*), Cinnamon and Royal Ferns (*Osmunda cinnamonea*, *O. regalis*), Northeastern Lady Fern (*Athyrium felix-femina*), Sensitive Fern (*Onoclea sensibilis*), Bulbet and Fragile Ferns (*Cytopteris bulbifera*, *C. fragilis*), Fowl Manna Grass (*Glyceria striata*), Wood-sorrel (*Oxalis montana*), Gold-thread (*Coptis trifolia*), Naked Mitrewort (*Mitella nuda*), Enchanter's Nightshade (*Circaea lutetiana*), Star-flower (*Trientalis borealis*), Foam Flower (*Tiarella cordifolia*), Three-leaved False Solomon's-seal (*Smilacina trifolia*), Bluebead Lily (*Clintonia borealis*), and Common Duckweed (*Lemna minor*).

6D White Cedar – Yellow Birch

A semi-open swamp dominated by White Cedar and Yellow Birch lies at the northeastern tip of the north outlier. Other tree species growing here are White Birch, Eastern Hemlock, Black Ash and White Spruce (sapling to 25 cm d.b.h.). More than 50 percent of this wetland is meadow marsh composed of species such as Canada Blue-joint (*Calamagrostis canadensis*), Red-stemmed Aster (*Aster puniceus*), Rough Goldenrod (*Solidago rugosa*), Boneset (*Eupatorium perfoliatum*), Jewelweed (*Impatiens biflora*), Wool-grass (*Scirpus cyperinus*), Red-osier Dogwood (*Cornus stolonifera*) and Willows (*Salix* spp.). The diverse meadow marsh component of this community includes many additional species, not listed here. A spring-fed stream flows through the south part of this swamp. Cuddy (1973) noted that dead elm trees were abundant in the south end of this swamp. The openness of this community has been caused in part by the cutting of cedar posts in the past. The signs of past grazing and trampling by cattle are still evident.

6E Tamarack – White Spruce – White Cedar – Balsam Fir – White Birch – Black Ash

There is a large wetland complex of closed treed swamp (6E), more open treed swamp (6F) and shrub-rich marsh (9A) on the eastern boundary of the park, just west of the 3rd line and north of its intersection with Dufferin County Road 8. This wetland is situated in a spillway channel that is underlain by Queenston shale bedrock. A steep slope, covered by mixed and deciduous forest, runs along the western edge of the wetland. The headwaters for a tributary of the Nottawasaga River rise within this wetland and flow south to join the Nottawasaga River in the Hockley Valley east of Glen Cross.

At the south end of the wetland is a treed swamp community dominated by Tamarack and White Spruce (sapling to 25 cm d.b.h.). White Cedar, Balsam Fir, White Birch, Black Ash and Balsam Poplar are important associates. The site is very wet with frequent pools of standing water. Speckled Alder (*Alnus rugosa*) and shrub willows (*Salix* spp.) occur in the understorey. The ground is covered with mats of mosses and herbaceous species, such

as: Water Horsetail (*Equisetum fluviatile*), Marsh Fern (*Thelypteris palustris*), Sensitive Fern (*Onoclea sensibilis*), Naked Mitrewort (*Mitella nuda*), Bunchberry (*Cornus canadensis*), Three-leaved False Solomon's-seal (*Smilacina trifolia*), American Water-horehound (*Lycopus americanus*), Square-stemmed Monkey flower (*Mimulus ringens*), Cut Grass (*Leersia oryzoides*), Red-stemmed Aster (*Aster puniceus*) and Spotted Joe-Pye Weed (*Eupatorium maculatum*). This is the only location in the park where Marsh-marigold (*Caltha palustris*) was observed.

The 3rd line divides the treed swamp community into two parts. Beside this gravel road, there is a lot of litter and garbage. The culvert underneath this road, which connects both parts of the treed swamp, may be partially blocked. The part of the treed swamp on the east side of the road appears to be wetter and more disturbed than that on the west side.

6F White Cedar – White Birch – White Spruce

The treed swamp community (6E) described above becomes more open to the north and merges with shrub-rich marsh (9A). Younger White Cedar, White Birch and White Spruce dominate this more open phase, providing about 30 to 40 percent cover. Shrub-rich marsh, as described under community 9A, forms the rest of the community.

The water levels in this wetland appear to have changed relatively recently (*i.e.*, in the last 12 years, since the 1978 aerial photography was taken.). Dieback of White Cedar, White Birch and shrub willows is evident in this more open phase of the treed swamp community. Water level changes could be related to drainage changes made immediately downstream during improvements to Dufferin County Road 8, about seven years ago.

Significant Species of Mixed Swamp (6)

The Great St. John's-wort (*Hypericum ascyron*), found in communities 6D and 9B, is considered a locally significant species in the park. Cuddy (1973b, p. 71) observed Striped Coral-root (*Corallorhiza trifida*) in the mixed swamp community (6C) in the south outlier valley. *Corallorhiza trifida* is considered a species of interest in the park.

7 CONIFER SWAMP

The valley of Sheldon Creek, in the eastern part of the park is forested with White Cedar and very occasional Yellow Birch. This large conifer swamp (6.5 ha in size) shades Sheldon Creek. This section of Sheldon Creek is an excellent spawning area for Brook Trout (*Salvelinus fontinalis*) (Hood pers. comm.). Cold springs along the valley slopes feed into the stream. White Cedar also grows on the valley slopes. In the middle of the swamp, there is a fenced cattle path leading down to the stream.

8 BOG

8A Open Low Shrub Bog

A kettle depression, set in the steeply rolling moraine southwest of McCarston's Lake, has a very small example of open low shrub bog at its centre. *Sphagnum palustre* forms a microtopography of hummocks and hollows. Leatherleaf (*Chamaedaphne calyculata*), Cinnamon Fern (*Osmunda cinnamomea*) and Royal Fern (*Osmunda regalis*) dominate the Sphagnum moss hummocks, and grow together with Marsh Fern (*Thelypteris palustris*), Gold-thread (*Coptis trifolia*), Three-leaved False Solomon's-seal (*Smilacina trifolia*), Wild Lily-of-the-valley (*Maianthemum canadense*). Labrador-tea (*Ledum groenlandicum*), Winterberry (*Ilex verticillata*), Witherod (*Viburnum cassinoides*), Bunchberry (*Cornus canadensis*), Creeping Snowberry (*Gaultheria hispidula*) and Wintergreen (*Gaultheria procumbens*) occur scarcely, with one to a very few plants of each species present. In the hollows interspersed between hummocks, there are small, shallow pools with *Drepanocladus fluitans*, Bog Buckbean (*Menyanthes trifoliata*), Mild Waterpepper (*Polygonum hydropiperoides*), Water-horehound (*Lycopus uniflorus*), Swamp Candles (*Lysimachia terrestris*), and Wool Grass (*Scirpus cyperinus*).

8B Treed Bog

The small, open bog is ringed with treed bog composed of Red Maple, Hemlock and Yellow Birch with the same *Sphagnum* hummock and hollow microtopography and abundant Cinnamon and Royal Fern. The treed bog and open low shrub bog areas cover a very small area, approximately 0.1 ha. A narrow border of mixed swamp (community 6A) surrounds the edge of the depression. Very shallow pools of water and patches of saturated soil line the edge of the depression at the base of the slope, creating a very shallow and incomplete moat.

This small acid wetland is raised above the level of McCarston's Lake by approximately 12 to 15 m. Drainage out is restricted, although there is a natural spillway on the northeast side of the wetland where water could overflow in times of very heavy run-off. On the Vegetation Matrix (Figure 3), this site was considered to be colder-than-normal, with an organic substrate and with a moisture regime ranging from wet to saturated to open water.

The location of this small kettle bog is on file at the Southern Region office of the Ministry of Natural Resources, Aurora. It is not shown on Map 1, Vegetation because this small, sensitive site could be damaged by even very low levels of visitation.

Significant Species of Bog (8)

The Witherod (*Viburnum cassinoides*) reported by Cuddy (1973a) is considered a locally significant shrub, as it is an addition for Wellington-Dufferin to Riley (1989).

A number of other species of acid bog habitats occur only at this location within the park, and are therefore considered species of interest: Leatherleaf (*Chamaedaphne calyculata*), Creeping Snowberry (*Gaultheria hispidula*), Wintergreen (*Gaultheria procumbens*), Winterberry (*Ilex verticillata*), Labrador-tea (*Ledum groenlandicum*), *Buckbean (Menyanthes trifoliata*) and Sphagnum palustre.

9 MARSH

A marsh is "... a mineral wetland or a peatland that is periodically inundated by standing or slowly moving water. Surface water levels may fluctuate seasonally, with declining levels exposing drawdown zones of matted vegetation or mudflats. The waters are rich in nutrients, varying from fresh to highly saline. The substratum usually consists of mineral material, although occasionally it consists of well-decomposed peat. The soils are predominantly Gleysols, with some Humisols and Mesisols. Marshes characteristically show zonal or mosaic surface patterns composed of pools or channels interspersed with clumps of emergent sedges, grasses, rushes, and reeds, bordering grassy meadows and peripheral bands of shrubs or trees. Submerged and floating aquatics flourish where open water areas occur." (National Wetlands Working Group 1988, p. 421)

The marsh communities in the park have been divided into four types which are described below and mapped on Map 1, Vegetation, where possible. While minor in extent, comprising approximately 5.6 ha, the marshes add to the overall diversity of habitats in the park.

9A Shrub-rich Marsh

Shrub-rich marsh occupies the northern third of the wetland complex on the eastern boundary of the park, just west of the 3rd line. This wetland lies in a spillway channel that is underlain by Queenston shale bedrock. The headwaters of a cold, spring-fed stream emanate in it and flow through it. The whole marsh is flooded and in places there are deeper pools of water.

Shrub thickets of willow (*Salix* spp.) and Red-osier Dogwood (*Cornus stolonifera*) grow in shallow water, to 15 cm deep, together with sedges (*Carex pseudo-cyperus*), Cut Grass (*Leersia oryzoides*), Water Horsetail (*Equisetum fluviatile*), Cattail (*Typha latifolia*), Boneset (*Eupatorium perfoliatum*), and Reed Canary Grass (*Phalaris arundinacea*). Some of the other species found in this marsh are: Canada Blue-joint (*Calamagrostis* *canadensis*), Red-stemmed Aster (*Aster puniceus*), Water-plantain (*Alisma plantago-aquatica*), Bulbous Water-hemlock (*Cicuta bulbifera*), Jewelweed (*Impatiens biflora*), Bittersweet (*Solanum dulcamara*), Common Mint (*Mentha arvensis*), Green-fruited Bur-reed (*Sparganium chlorocarpum*), Water Cress (*Nasturtium officinale*) and Common Duckweed (*Lemna minor*).

To the south, shrub-rich marsh grades into semi-open treed swamp (community 6F) and treed swamp (community 6E). The dieback on the willow thickets in the shrub-rich marsh (9A) may be related to relatively recent changes in water levels, changes that have occurred since the 1978 air photos were taken. Water level changes could be related to drainage changes made immediately downstream, during improvements to Dufferin County Road 8, about seven years ago. There is garbage in the marsh adjacent to the 3rd line. Gravel from the roadbed is being gradually pushed into the wetland.

9B Meadow Marsh

A narrow band of meadow marsh lines some of the many stream courses in the park, especially those sections flowing through open country. Small patches of meadow marsh are also found along the shoreline of McCarston's Lake and some of the other ponds on the property. Some of the locations where meadow marsh occurs are shown on Map 1, Vegetation. Other sites were too small to map. Plant associations and dominants vary at different locations. Some of the typical species of this community include: Reed Canary Grass (*Phlaris arundinacea*), Jewelweed (*Impatiens biflora*), Cut Grass (*Leersia oryzoides*), Boneset and Spotted Joe-Pye Weed (*Eupatorium perfoliatum* and *E. maculatum*), Cattail (*Typha latifolia*), Black Bulrush (*Scirpus atrovirens*), Sensitive Fern (*Onoclea sensibilis*), Nodding Beggarticks (*Bidens cernua*), Common Mint (*Mentha arvensis*), Water-horehounds (*Lycopus uniflorus*, *L. americanus*), Water-speedwell (*Veronica anagallis-aquatica*) and Water Cress (*Nasturtium officinale*).

9C Cattail Marsh

In the south outlier valley, at the base of the main escarpment slope, is a small pocket of Cattail Marsh (*Typha latifolia*) surrounded by mixed forest. Springs along the base of the slope discharge into the marsh. Another cattail marsh, identified as an ecologically significant area by Cuddy (1973a), was flooded with the construction of a beaver dam and pond in 1987 or 1988. See community 10B.

9D Emergent Marsh

An emergent marsh community grows in the shallow water zones of some of the ponds in the park. For example, at McCarston's Lake, aquatic vegetation in the shallow water near shore consists of Common Arrowhead (*Sagittaria latifolia*), Common Duckweed (*Lemna minor*) and Stonewort (*Chara*). A small woodland pond in a depression on the moraine west of McCarston's Lake is carpeted with Common Duckweed (*Lemna minor*).

Significant Species of Marsh (9)

Two locally significant species were noted in marsh communities: Golden Ragwort (*Senecio aureus*) in the shrub-rich marsh (9A) and Great St. John's-wort (*Hypericum ascyron*) in meadow marsh (9B).

LACUSTRINE – OPEN WATER

In addition to McCarston's Lake, which is the only natural lake in Mono Township, there are eight man-made ponds within the park and one pond created by beaver (10B). Prior to 1986, there was one more man-made pond. The dam of the southerly pond of the pair of ponds on the glacial spillway near the Carriage Trail (10E) broke in 1986 or 1987, and it has not yet been reconstructed. Each water body has been identified by a letter for easy reference on Map 1, Vegetation, and in the discussion that follows. Together these water bodies cover approximately 7.9 ha, or 1.1 percent of the park area.

10A McCarston's Lake is set in a depression on the steeply rolling moraine uplands west of the escarpment. The slopes rising from the lake are completely forested, with Sugar Maple forest on the west and south, and with mixed forest of White Cedar, White Birch, Eastern Hemlock and Sugar Maple on the north and east. This creates a beautiful natural setting and excellent wildlife habitat. The lake is part of the headwaters of Sheldon Creek. A small stream enters the lake on the west side. The lake is almost certainly fed by natural springs as well. An outlet stream flows from the southeast corner of the lake.

The depth to lake bottom measured 875 cm on 13 January 1991 when a core of lake sediments was taken through the ice by McAndrews *et al.* Dr. McAndrews of the Royal Ontario Museum has initiated a research project at McCarston's Lake designed "... to reconstruct the vegetation history at Crawford Lake and McCarston's Lake and to infer effects of climatic change and prehistoric and historic human impact on the vegetation." (McAndrews 1990, p. 1-2). During this project, the lake sediments have been cored and "... analysed for fossil pollen, plant macrofossils, radiocarbon age, and geochemistry by loss-on-ignition."

There are dead trunks of White Cedar and White Birch in a shallow nearshore zone around the lake, indicating that water levels may be higher now than they used to be at one time in the past. Patches of meadow marsh (community 9B) are found along the shoreline of the lake and an emergent marsh community (9D) grows in shallow water.

The fauna of McCarston's Lake was documented during a study of the fauna of ten lakes associated with the Niagara Escarpment (Kott and MacCrae-Mitchell 1990). The lake was alkaline (pH 9.1, seasonal range 8.7-9.3; total dissolved solids 98 mg/l, range 90-100). Three species of fish were collected: Largemouth Bass (*Micropterus flavescens*), Yellow Perch (*Perca flavescens*) and Brown Bullhead (*Ictalurus nebulosus*). Yellow Perch and Largemouth Bass were the dominant species, but their numbers were restricted. It is possible that these fish species were stocked in the lake at some time in the past. Eastern Newts, Green Frogs, Leopard Frogs and high numbers of Painted Turtles were observed. The lake is rich in molluscs. Nine species of snails and 3 species of fingernail clams were collected (see Appendix F).

There is evidence of past beaver activity around the lake, for example, several felled trees gnawed by Beaver. In the spring of 1974, the author observed Beaver at the lake, but there are no signs of recent activity.

At the time of park acquisition, there was a cottage, boathouse and dock on the east side of the lake. Broken pieces of the dock and a patch of Periwinkle (*Vinca minor*) on the slopes by the former cottage site are all that remain.

10B Beaver constructed a dam on this branch of Sheldon Creek in 1987 or 1988, creating a beaver pond. The beaver pond is evident on the aerial photography taken in 1988 (1:20,000 scale). The flooded area used to consist of mixed swamp, cattail marsh, shrub thickets and a successional Balsam Poplar-White Birch stand. The Beaver dam and pond can be viewed along its east side from a short trail that branches off the main Bruce Trail.

10C Further upstream on this branch of Sheldon Creek is a small, man-made pond surrounded by wooded slopes, and mixed forest. Springs rising at the base of the escarpment, north of the Jacob's Ladder area, are the source of the pond. Kingfishers used to nest in the sandy bank north of the pond, but have not been observed here for several years. A new bottom-draw outflow was installed in 1989.

10D This man-made, trout pond is on the same branch of Sheldon Creek downstream from the Beaver pond. A new bottom-draw, outflow was installed in June 1989, after the previous outflow was breached in late winter 1989 (Winters pers. comm.).

10E The dam of this pond on the glacial spillway, just south of 10D, near the Carriage Trail, broke in 1986 or 1987. Hood (pers comm.) recollects spring 1986 ± a year; Winters (pers. comm.), fall 1987. It has not yet been reconstructed. The pond bottom is filling in with sapling Balsam Poplar regeneration. The stream that flowed through this pond rises in the south outlier valley and flows north to 10E, and then northeast to join other tributaries of Sheldon Creek.

10F The two tributaries of Sheldon Creek discussed above (in 10D and 10E), and the tributary flowing from McCarston's Lake, meet in the forested valley east of 10D. Sheldon Creek descends through deciduous forest, mixed forest and conifer swamp to another man-made pond, 10F at the eastern end of the valley. The pond maintains a very cold water temperature throughout the summer (Hood pers. comm.).

10G This pond in the northeastern corner of the park is surrounded by meadow marsh on the west, north and east sides. It lies on a stream that emanates in fields at the northern tip of the north outlier. The grass on the dam and west and east sides of the pond is cut. A pump beside the pond indicates that it has been used for irrigation by the adjacent landowner, whose home overlooks this pond.

10H Downstream from 10G, there is a small, shallow pond used to water cattle. A farmer leases this part of the park as grazing land. The water is very turbid and supports algae, submerged aquatic vegetation and water-plantain (*Alisma plantago-aquatica*). The dam has no outflow, instead a culvert has been laid on top of the dam.. In August 1990, there was no flow through the culvert, although there was a small amount of leakage through the dam. The stream disappears at this point. It may flow intermittently through the valley south of this dam, particularly in times of high run-off.

10 I, J and K Three ponds at the south end of the south outlier valley, by Mono Centre, provide excellent wildlife habitat and interpretative opportunities. These ponds are fed by springs that rise along the foot of the main escarpment and flow into the large mixed swamp at the south end of the south outlier valley. The stream which drains these ponds flows southward to in the Nottawasaga River in the Hockley valley east of Glen Cross.

Fry and fingerling trout can be observed in the clear waters of these ponds. On opening day of the fishing season, in April 1990, fishermen were catching Brook Trout (*Salvelinus fontinalis*) 20 cm long or more from these ponds. Herptiles recorded from these ponds include: Eastern Newt, American Toad, Spring Peeper, Tetraploid Gray Treefrog, Striped Chorus Frog, Wood Frog, Northern Leopard Frog, Green Frog, Common Snapping Turtle and Painted Turtle.

Pond 10K is a small, shallow pond less than 2 m deep. A wet, sandy margin of the pond supports Variegated Scouring-rush (*Equisetum variegatum*), Loesel's Twayblade (*Liparis loeselii*), Nodding Ladies'-tresses (*Spiranthes cernua*), sedge (*Carex aurea*) and rushes (*Juncus* spp.).

Significant Species of Open Water (10)

The following species of interest grow in a very small area along the wet sandy margin of pond 10K: Variegated Scouring-rush (*Equisetum variegatum*), Loesel's Tway blade (*Liparis loeselii*) and Nodding Ladies-tresses (*Spiranthes cernua*). This is a very sensitive habitat, which could be damaged by any amount of foot traffic.

ANTHROPOGENIC – HUMAN-MODIFIED

Vegetation types created by human modifications of the natural environment, such as fields, hawthorn savanna and plantations, occupy approximately 430.7 ha or 58.3 percent of the park.

11 FIELDS

The old field communities are divided into three categories on Map 1, Vegetation and in the discussion that follows. The perimeters of many old fields are lined with hedgerows of mature trees of various species, for example, Sugar Maple, Black Cherry, Basswood, White Birch, American Beech. These mature hedgerows, and the small stands of mature trees that remain in some old fields, add beauty, diversity and cover for wildlife, to the old field areas of the park.

11A Pasturelands

The pasturelands which are presently grazed, or which have been grazed, mowed or cultivated recently, have been mapped separately. These fields are typically dominated by grasses, such as Smooth Brome Grass (*Bromus inermis*), Orchard Grass (*Dactylis glomerata*), Timothy (*Phleum pratense*), Canada Blue Grass (*Poa compressa*), Kentucky Blue Grass (*Poa pratensis*), and Goldenrods (*Solidago canadensis*, *S. graminifolia*). The composition of the different fields varies depending on their past history. These fields cover approximately 171.3 ha.

11B Old Fields with Successional Thickets

Many of the fields in the park, an area of about 202.8 ha, have been left uncultivated for a longer period. These are in various stages of secondary succession, the process through which forest re-establishes itself on open sites. In addition to the grasses and goldenrods listed above, other typical herbaceous species include: Pussytoes (*Antennaria neglecta*), Cypress Spurge (*Euphorbia cyparissias*), Dogmint (*Satureja vulgaris*), Poverty Oat Grass (*Danthonia spicata*), Yellow and Orange Hawkweeds (*Hieracium caespitosum*, *H. aurantiacum*), Common Milkweed (*Ascelpias syriaca*), Spreading Dogbane (*Apocynum androsaemifolium*) and Violet (*Viola septentrionalis*). Scattered about the old fields in thickets, or growing singly are shrubs such as, Chokecherry (*Prunus virginiana*), Hawthorn (*Crataegus* spp.), Raspberries (*Rubus strigosus*, *R. allegheniensis*), Red-osier Dogwood (*Cornus stolonifera*), Staghorn Sumac (*Rhus typhina*), Willow (*Salix* spp.) and Juneberry (*Amelanchier arborea*). The trees which are becoming established as seedlings, saplings and young successional groves, include species such as: White Birch, Trembling and Large-toothed Aspen, White Elm, White Cedar, Sugar Maple, White Ash, Black Cherry and other forest species too. Several abandoned orchards are included with the old field community (11B).

Of special interest is a small stand of about 60 naturally seeded, young White Pine in an old field near UTM 730765. These young pine are growing adjacent to six large White Pine trees, the only White Pine found in the natural forests of the park. Some of the young White Pine reach 9 m in height and 15 cm d.b.h.

11C Old Fields with Self-seeded Scotch Pine

There are several old field and successional communities in the park in which young Scotch Pine is establishing itself vigorously. Adjacent plantations provide the seed source. These old fields have been identified as community 11C on Map 1, Vegetation. Old fields with self-seeded Scotch Pine now cover about 23 ha or 3.1 percent of the park. The removal of all self-seeded Scotch Pine and the Scotch Pine plantations in the park is recommended in Chapter III. The concern is that the Scotch Pine in the park are producing seed and functioning as a weedy introduced species. Young trees, less than 2 m high, were observed with cones.

The three main areas of concentration are: 1) the plateau above the escarpment, east of the second line and south of the Carriage Trail; 2) on the plateau of the south outlier; and 3) on the spillway plain below the north tip of the south outlier. The old fields on the plateau of the south outlier (location 2) contain two planted windrows, one of Scotch Pine and another of Scotch Pine mixed with White Cedar and White Birch. The trees reach 9 m in height and are 10 to 13 cm d.b.h. At the third location, on the spillway plain below the north tip of the south outlier, there are young, self-seeded Jack Pine mixed in with the Scotch Pine. There are other locations throughout the park where young Scotch Pine is establishing itself in old fields, either singly or in small groups of trees.

Significant Species of Fields (11)

Three locally significant species were found in old field communities (11B). Northern Adder's-tongue Fern (*Ophioglossum vulgatum*) grows at one location in the south outlier valley, in thickets of Staghorn Sumac, at the edge of deciduous forest. Juneberry (*Amelanchier arborea*) and Hoary Vervain (*Verbena stricta*) are additions for Wellington-Dufferin to the Distribution and Status of the Vascular Plants of Central Region (Riley 1989). One species of interest occurs in the old field community (11B). One clump of Common Juniper (*Juniperus communis*) was found above the escarpment in the north part of the park. Only one other single plant of Common Juniper was observed in the park, in community 1D on the north outlier.

12 HAWTHORN SAVANNA

An area of Hawthorn savanna has developed in the open, steep moraine slopes above the escarpment, northeast of McCarston's Lake. This savanna surrounds one of the highest points of land in the whole park, a hill which offers superb views of the park and surrounding landscape in every direction. Scattered stones and boulders dot the steep slopes.

A savanna is a "... plant community where trees are a component but where their density is so low that it allows grasses and other herbaceous vegetation to become the actual dominants of the community." (Curtis 1959, p. 325). Hawthorns (*Crataegus* spp.), spaced 10 to 20 m or more apart, dominate most of the savanna. In some sections, White Cedar predominates, especially at the savanna's western edge, and on the north slope of the viewing hill. Other woody saplings and shrubs growing in the savanna include: Chokecherry (Prunus virginiana), Black Cherry (*Prunus serotina*), Pin Cherry (*Prunus pensylvanica*), Apple (*Pyrus malus*), Sugar Maple, White Birch, White Ash, Trembling Aspen, Red-osier Dogwood (*Cornus stolonifera*), Staghorn Sumac (*Rhus typhina*), Riverbank Grape (*Vitis riparia*) and Common Blackberry (*Rubus allegheniensis*). The ground cover is similar to that described for community 11B, Old Fields with Successional Thickets. This hawthorn savanna was grazed by cattle up until about 1976.

13 PLANTATION

Plantings composed mainly of coniferous species occur at a number of different locations in the park. Plantations comprise about 23.8 ha or 3.2 percent of the park area. The following plantations are shown on Map 1, Vegetation.

13A Red Pine – White Pine

The oldest plantation in the park grows on a dry mesic to mesic, sandy site in the central part of the south outlier valley. The Red Pine and White Pine growing here were planted sometime in the 1930's (Coleman pers. comm.). Most of the plantation is Red Pine, with several rows of White Pine along the north side. The trunk diameter of these pines (d.b.h.) ranges from 23 to 45 cm.

This area in the park is known as "McCarston's Grove," or the "Ravine," or more recently as the "Pines". Burns Church, in Mono Centre, held an annual picnic on the 24th of May in McCarston's Grove, during a period spanning several decades, from sometime before 1903 to 1930 (Turnbull 1988, p. 31). At that time, there were about 6 ha of open ground where ball games were played (Coleman pers. comm.). A photograph in the 150 year history of Burns Church, Mono Centre (Turnbull 1988) shows people attending a 24th of May picnic at McCarston's Grove in 1914.

13B White Spruce

At the north end of the park, above the escarpment, a windrow of White Spruce lines a fenceline and part of the 25 sideroad. Another small plantation of White Spruce occurs north of Sheldon Creek.

13C Scotch Pine

Scotch Pine plantations occur at two locations in the park, occupying about 6.2 ha in total. The Scotch Pine at one site grow in very shallow soils at the rim of the Niagara Escarpment, north of Mono Centre near UTM 743760. Scotch Pine extends back from the rim into the old field community. These Scotch Pine appear to have been planted, but may in fact be self-seeded, as are the Scotch Pine in the old fields lying to the west.

There is a larger Scotch Pine plantation on the plateau of the south outlier. The trees in this plantation were probably planted by a former owner as a Christmas tree crop. They are now 9 to 11 m high with diameters of 10 to 13 cm d.b.h. Some natural regeneration is occurring within the plantation.

13D Jack Pine

North of Sheldon Creek, on steeply sloping hillsides just west of the 3rd line are two fenced plantations of Jack Pine. The northerly planting has White Pine along its north and west sides. The trees reach 9 to 13 m in height and are 5 to 13 cm d.b.h. There is White Cedar regeneration in the understorey of the southerly plantation.

13E White Pine – Scotch Pine – White Spruce

There are plantations at the south end of the park, near the park entrance from Dufferin County Road 8 and Mono Centre, and beside the three ponds, 10I, 10J and 10K. It appears that this south part of the park, near Mono Centre, was part of a lumberyard around the turn of the century. A photograph from around 1905 in "Still Burns Their Flame" shows this area as a flat, treeless landscape (Turnbull 1988, p. 92). The three south ponds were constructed some time after this date.

Beside the ponds there are now mixed plantations of White Pine, Scotch Pine, and White Spruce. Planted White Spruce, with some Scotch Pine and White Pine also extend a short distance north along the sandy farm track through the south outlier valley (the main Bruce Trail), and blend in with the natural mixed forests here. Some of the stands by the ponds are composed entirely of Scotch Pine or of Scotch Pine with White Pine. Trees reach 15 to 21 cm in height and 10 to 30 cm d.b.h. Within some of these stands there is a lot of natural regeneration in the understorey, of species such as Sugar Maple, Alternate-leaved Dogwood (*Cornus alternifolia*) and Mountain Maple (*Acer spicatum*).

East of the park entrance along Dufferin County Road 8, there is a stand in which White Cedar and Balsam Poplar is mixed with planted White Pine, White Spruce and Scotch Pine.

On slopes descending from the southeast side of the south outlier, in a field beside the hydro line, is an older, mixed plantation of White Spruce and Scotch Pine, with some Red Pine. Trees are 9 to 11 m high and some reach 15 to 18 m.

13F Old Field with Plantation

At the south end of the south outlier is an old field with scattered Scotch Pine along its western, northern and eastern edges. The Scotch Pine are 6 to 8 m high and 5 to 8 cm d.b.h. The Scotch Pine are producing seed and spreading. A Red Pine plantation of similar age lines the fencerow along the south side of the field, beside mature Sugar Maple.

In the southeast corner of the park is an old field with a row of White Spruce and scattered Scotch Pine, some of which is self-seeded. These trees shows signs of past grazing.

Significant Species of Plantation (3)

The nationally, provincially and regionally rare, Rugulose Grape Fern (*Botrychium rugulosum*) has been collected from the Red Pine – White Pine plantation in the south outlier valley (community 13A). The species was identified by W.H. Wagner, an expert at the University of Michigan who has studied the genus *Botrychium* extensively (Wagner and Wagner 1982).

CHAPTER III: PLANNING CONSIDERATIONS

(i) SIGNIFICANCE OF MONO CLIFFS PROVINCIAL PARK

The Niagara Escarpment received international recognition in February 1990 when it was designated by UNESCO (United Nations Educational, Scientific and Cultural Organization) as a World Biosphere Reserve. The designation recognizes the unique natural features and ecological importance of the area in which land use is regulated under the Niagara Escarpment Plan. The Niagara Escarpment is Canada's sixth Biosphere Reserve. Long Point on the north shore of Lake Erie is the only other Biosphere Reserve in Ontario.

Mono Cliffs Provincial Park is the only major exposure of the Niagara Escarpment along its central section, between Credit Forks and Lavender Falls. Within the park, representative escarpment habitats are exposed for more than 8 km along the escarpment face and around two dolostone outliers. In the surrounding region, the Niagara Escarpment is largely buried by moraine and outwash deposits.

The life and earth science features represented at Mono Cliffs Provincial Park are provincially significant. Land for the park was acquired in the 1960s because of its provincially significant biological and geological features, as well as its spectacular scenery. The park master plan, published in 1974, included a large **Natural Zone** which covered "... most of the woodland, rough grass areas and other key ecological areas" in the park (Ontario Ministry of Natural Resources, 1974, p. 24, 25). A comprehensive study of "Significant Natural Areas Along the Niagara Escarpment" identified Mono Cliffs as a **provincially significant candidate nature reserve**, offering the best representation of escarpment-related features in the Dufferin section of the Niagara Escarpment (Park Planning Branch 1976, p. 127). That study was a major component of provincial planning for the Niagara Escarpment and the park system along its length. The "Proposed Plan for the Niagara Escarpment" zoned the provincially significant biological and geological features at Mono Cliffs as **Escarpment Natural Area** (Niagara Escarpment Commission 1979). Mono Cliffs was also identified as a **provincially significant Area of Natural and Scientific Interest or ANSI**, for both life and earth science features, in the Huronia District Land Use Guidelines (Ontario Ministry of Natural Resources 1983).

The natural and scientific values identified by previous studies (Cuddy 1973, Lindsay 1973, Park Planning Branch 1976) have been confirmed and augmented by this biological inventory and recent scientific studies (Bogart 1991, Britton 1981 and pers. comm., Kott and MacRae-Mitchell 1990, Larson 1989, 1990, pers. comm., Lynn and Olson 1990, McAndrews 1990, McAndrews and Campbell 1990, Savage 1990 and pers. comm. and Varga pers. comm.). The fact that three Boards of Education have located their Outdoor Education Centres close to the park attests to the interpretative and educational values of the area. Thousands of students, teachers, Bruce Trail users, naturalists and youth groups visit the park each year.

(ii) EVALUATION OF THE PROPOSED NATURE RESERVE ZONE

This section evaluates the life science features within the area identified as provincially significant by previous studies (Park Planning Branch 1976, Ontario Ministry of Natural Resources 1983). The natural and scientific values of this area are summarized in terms of the five criteria used for the selection and evaluation of candidate nature reserves and Areas of Natural and Scientific Interest across southern Ontario, namely representation, diversity, condition, ecological considerations and special features (Lindsay 1984). These natural and scientific values are outlined in greater detail in section (iii) of this chapter.

The large, provincially significant, life science Nature Reserve Zone proposed for the park by this biological inventory and evaluation is shown in detail on Maps 1 and 2 and is also shown on Figures 4 and 5, p. 45 and 51. It includes all of the escarpment face, the forests surrounding McCarston's Lake, the two outliers, the wooded outlier valleys, and the forests and wetlands along Sheldon Creek. This is essentially the same area that was identified by previous studies as a **provincially significant candidate nature reserve** (Park Planning Branch 1976) and a **provincially significant Area of Natural and Scientific Interest or ANSI** (Ontario Ministry of Natural Resources 1983). This study confirms and substantiates its provincial significance.

Minor adjustments have been made to the boundary of the provincially significant Nature Reserve Zone, mapped by previous studies (See Chapter I (i) b), based on vegetation, flora, fauna, special features and ecological considerations. For example, the continuously forested slopes north of McCarston's Lake form an important part of its watershed and have been included. Areas of old field communities with excellent advanced regeneration, where natural succession will lead in time to associations typical of the park, have been included to provide buffering to escarpment rim, plateau and talus slope sites and to add habitat and wildlife diversity. Areas of Scotch Pine plantation and old fields with self-seeded Scotch Pine have been excluded, until the Scotch Pine in these areas can be removed.

Note that the provincially significant, life science features extend outside of the provincial park boundary to include critical headwater wetlands and forests west of McCarston's Lake. Where these features extend beyond the park onto private lands they have been mapped as a provincially significant, Area of Natural and Scientific Interest or ANSI on Figures 4 and 5 and on Maps 1 and 2.

Representation

Mono Cliffs offers outstanding representation of Niagara Escarpment features which are of restricted occurrence along this central section of the escarpment. It is the only major exposure of the Niagara Escarpment between Credit Forks and Lavender Falls. Escarpment habitats are exposed for more than 8 km along the escarpment face and around two dolostone outliers. A wide range of physical sites and distinctive vegetation communities are associated with the thinly-soiled bedrock pavement rim at the cliff-edge, the high and low cliffs and cliff-face fissure systems, the talus slopes and steep bedrock-controlled slopes. These habitats provide specialized niches for an escarpment-related flora rich in ferns and fern-allies. Mono Cliffs offers the best representation of Niagara Escarpment features of all the provincial parks located within its site district, Site District 6-7.

A number of other communities and habitats are also very well represented: deciduous and mixed forests on sandy moraine uplands and spillway flats, a variety of wetlands (mixed swamp, conifer swamp, bog, marsh), coldwater streams, open water habitats at McCarston's Lake, a beaver pond and eight man-made ponds, and successional communities developing in old fields.

Diversity

An excellent diversity of habitats exists within the provincially significant Nature Reserve Zone. This inventory identified and mapped 53 vegetation communities within the park. These cover the complete range of moisture regimes, from arid to open water, and occupy rock, sand, loam, clay and organic substrates, and all three microclimatic regimes on the Vegetation Matrix (Figure 3). The major landform types within the park include sandy moraine uplands, the Niagara escarpment and its two outliers, sandy spillway deposits and wetlands.

Mono Cliffs protects cliff-edge and cliff-face forests that are part of an old growth forest community extending along the length of the Niagara Escarpment. The presence of a complete range of escarpment exposures along the face of the Niagara Escarpment and around the exposed faces of the two outliers is unique. Mono Cliffs is the only provincial park that protects outliers to the escarpment in their entirety. The north outlier and the valley separating it from the escarpment face are continuously forested. Few protected areas along the Niagara Escarpment contain such a range of escarpment sites and aspects within one area. There are no other protected areas within Site District 6-7 with such a range of escarpment sites, aspects, communities and species.

Successional communities, in various stages of natural succession are developing in old fields and along forest edges, creating excellent wildlife habitat.

The flora of the park is diverse, with 470 species of vascular plants recorded. The documented fauna consists of 22 species of mammals, 82 species of birds, of which 52 are considered to breed within the park, 19 species of amphibians and reptiles, 4 species of fish and 12 species of molluscs. Most of these species occur within the provincially significant Nature Reserve Zone. Further studies of understudied groups (*e.g.* small mammals, fish) will almost certainly yield more species.

Condition

With the exception of some escarpment communities, such as the old growth White Cedar forests along the cliff-edge and cliff-face, most of the park has been logged selectively or cleared for agriculture in the past. Talus slope and rim forests on the north and south outliers show signs of past fires. Much of the non-escarpment natural area in the park was accessible to grazing farm animals up until the 1960s when land for the park was acquired.

However, in comparison with the landscape which surrounds the park area, a landscape of pastureland and agricultural fields with small remnant woodlots and wetlands, the natural communities at Mono Cliffs remain in excellent condition. Since the park's acquisition in the 1960s, some very positive changes have occurred to the park's vegetation. Its forests have matured, many fields have developed diverse, successional communities which complement these forests, and the removal of grazing from forests and talus slopes has probably increased the frequency of fern and moss communities. In the 18 years since the first ecological assessment of the park and the author's first field studies there (Cuddy 1973a, Lindsay 1973), the author has observed natural succession in old fields growing into young, natural forest associations typical of the park and the escarpment.

Some of the park's features are showing the effects of a high level of recreational use, particularly in certain sensitive and highly significant escarpment communities (rim, cliff, cliff-face fissure systems and talus slopes) and along certain sections of official and unofficial trails in sensitive and significant habitats.

Ecological Considerations

Ecological considerations such as size, shape, watershed position, and water and land linkages are important in selecting Nature Reserves. Large sites are more likely to maintain self-sustaining, stable and diverse communities. Species extinctions are less likely to occur in larger sites, linked sites or closely spaced sites than in small, isolated sites. Headwater areas and watershed units provide an opportunity for some degree of control over inputs.

A relatively large contiguous area has remained in natural vegetation at Mono Cliffs, because of the configuration of the escarpment and the two outliers. The large forested block surrounding McCarston's Lake and its headwater wetlands is linked to the Niagara Escarpment by a forested re-entrant valley. Within the park are many springs and seepage zones which form the headwaters of the five streams that flow through the park and feed into Sheldon Creek and the Nottawasaga River. These streams link swamp, marsh and open water communities.

Special Features

The park protects populations of the following significant plants: three nationally and provincially rare species, Rugulose Grape Fern (*Botrychium rugulosum*), Ginseng (*Panax quinquefolius*) and Hart's-tongue Fern (*Phyllitis scolopendrium*); three regionally rare species, Rock-cress (*Arabis hirsuta*), Green Spleenwort (*Asplenium viride*), and Mountain-ash (*Sorbus americana*); three species restricted geographically in Central Region, Walking Fern (*Camptosorus rhizophyllous*), Melic Grass (*Melica smithii*) and Holly Fern (*Polystichum lonchitis*); 17 locally significant species and 14 other species of interest (Table 2). Ginseng is a threatened species in Canada (Argus and Pryer 1990, White 1988).

Eastern Bluebird, a species considered to be nationally and provincially rare by the Committee on the Status of Endangered Wildlife in Canada (Risley 1981), and the Ontario Ministry of Natural Resources, nests in nest boxes placed in old fields throughout the park. Wild Turkey has been sighted in the park. This formerly native species is now being reintroduced to Southern Ontario and is considered to be rare in Central Region (Riley and Gould 1989).

The population of diploid Jefferson Salamander represents "... the northernmost known locality for 'pure' *Ambystoma jeffersonianum*" (Bogart 1991). Five other species of herptiles known from the park are also

Table 2: Significant Vascular Plants of Mono Cliffs Provincial Park

Species	Common Name	Community Number[1]	Significant Area
Nationally and Provincially Rare (Argus *et al.* 1982-87; Argus and Pryer 1990)			
Botrychium rugulosum	Rugulose Grapefern	13A	D
Panax quinquefolius	Ginseng	5D	A
Phyllitis scolopendrium (E)	Hart's-tongue Fern	5C,D	A,C,D
Regionally Rare in Central Region (Riley 1989)			
Arabis hirsuta (E)	Rock-cress	4A,B	D
Asplenium viride (E)	Green Spleenwort	4C	B
Sorbus americana	Mountain-ash	5B	A
Restricted Geographically in Central Region (Riley 1989)			
Camptosorus rhizophyllous (E)	Walking Fern	4,5	A,B,C,D
Melica smithii	Melic Grass	1E,5D	A
Polystichum lonchitis (E)	Holly Fern	5A	A
Locally Significant (Species restricted to escarpment-related niches (E), or found at only 1 or 2 locations in the park)			
Amelanchier arborea[2]	Juneberry	11B	D
Amelanchier spicata var. *spicata*[2]	Juneberry	1D	A,D
Asplenium trichomanes (E)	Maidenhair Spleenwort	3,4,5	A,B,C,D
Cryptogramma stelleri (E)	Slender Cliff-brake	4	A,B,C,D
Dentaria laciniata	Cutleaf Toothwort	1A	a
Dicentra cucullaria (E)	Dutchman's-breeches	1A,4B	C
Equisetum scirpoides	Dwarf Scouring-rush	1A	E
Hydrophyllum canadense	Canada Waterleaf	5C	C
Hypericum ascyron	Great St. John's-wort	6D,9B	A,D
Ophioglossum vulgatum	Northern Adder's-tongue Fern	11B	D
Pellaea glabella (E)	Smooth Cliff-brake	4	A,B,C,D
Polypodium virginianum (E)	Rock Polypody	3,4,5	A,B,C,D
Polystichum acrostichoides	Christmas Fern	1A	B
Senecio aureus	Golden Ragwort	9A	b
Verbena stricta	Hoary Vervain	11B	a
Viburnum alnifolium[2]	Hobblebush	1A	E
Viburnum cassinoides[2]	Witherod	8	B
Other Species of Interest			
Chamaedaphne calyculata	Leather-leaf	8	B
Corallorhiza maculata	Spotted Coral-root	1A,1D	A,B,D
Corallorhiza trifida	Striped Coral-root	6C	D
Dirca palustris	Leatherwood	1	B
Equisetum variegatum	Variegated Scouring-rush	10K	D
Gaultheria hispidula	Creeping Snowberry	8	B
Gaultheria procumbens	Wintergreen	8	B
Ilex verticillata	Winterberry	8	B

Table 2: Significant Vascular Plants of Mono Cliffs Provincial Park (cont'd)

Species	Common Name	Community Number[1]	Significant Area
Juniperus communis	Common Juniper	1D,11B	A
Ledum groenlandicum	Labrador-tea	8	B
Liparis loeselii	Loesel's Twayblade	10K	D
Menyanthes trifoliata	Bog Buckbean	8	B
Spiranthes cernua	Nodding Ladies'-tresses	10K	D
Sphagnum palustre	Sphagnum moss	8	B

(E) = A species restricted to escarpment-related niches.

[1] Refer to Chapter II, Table 1 for the vegetation communities that correspond to these numbers.

[2] An addition to the Distribution and Status of the Vascular Plants of Central Region for Wellington-Dufferin (Riley 1989).

considered to be uncommon and widespread in Central Region (Plourde *et al.* 1989): Pickerel Frog (*Rana palustris*), Redbelly Snake (*Storeria occipitomacalata*), Smooth Green Snake (*Opheodrys vernalis*), Ringneck Snake (*Diadophis punctatus*), and Milk Snake (*Lampropeltis triangulum*).

Within the park are sections of Sheldon Creek that are major reproductive zones for Brook Trout (*Salvelinus fontinalis*) (Hood pers. comm). These are extremely important and highly significant to the fish populations in Sheldon Creek (Imhof pers. comm.)

The park is very well known for its diverse fern flora. It supports 44 of the 96 species of ferns and fern allies that grow in Ontario (Britton 1985). Refer to Table 3, Ferns and Fern Allies of Mono Cliffs Provincial Park. A number of these ferns are restricted to the specialized niches associated with the calcareous bedrock of the Niagara Escarpment. In the past decade, a number of field trips for professional botanists, field naturalists and students interested in studying ferns and fern allies have selected the Mono Cliffs area as their destination.

Mono Cliffs is extremely important for scientific research. In recent years, researchers have conducted at least eight studies into different aspects of the park's natural history (See Chapter I (i) b). The recent scientific discoveries are highly significant, and yet much more remains to be studied and understood.

Larson (1989, 1990, pers. comm.) studied the White Cedar forests associated with the cliffs at Mono Cliffs and along the Niagara Escarpment and discovered some of the oldest, most intact, old growth forests in North America. At a small sample site within the park, Larson found trees greater than 300 years in age. One tree sampled in the park was 428 years in age and several were in the 350 to 400 year range.

McAndrews (1990, pers. comm.) is reconstructing the history of vegetation in the area since glaciation from pollen analysis of samples of the lake sediments underlying the bottom of McCarston's Lake. Scientific investigations of a deep fissure cave by Savage (1990 and pers. comm.) have identified the bones of 12 mammal species. The bones of Pika and Marten are of special significance, as these species no longer occur in this part of southern Ontario. At present, Pika occur only in western North America, on talus slopes and steep boulder-covered hillsides (Whitaker 1980). Marten occur no further south in Ontario than the southern limits of Algonquin Park. Bones of Fowler's Toad (*Bufo woodhousii fowleri*) were also found in the cave. At present Fowler's Toad is restricted in Ontario to sites along the shoreline of Lake Erie, although this species is widespread throughout the eastern United States (Green 1989).

Radiocarbon isotrace dating of the Pika bones found at Mono Cliffs has determined an age of 9000 years before present. The Marten bones date from 510 years before present. These radiocarbon dates, and the analysis of pollen in the cave sediments (McAndrews and Campbell 1990) are contributing data which can be used to reconstruct the vegetation and fauna of this part of southern Ontario since deglaciation.

(iii) SIGNIFICANT AREAS WITHIN THE PROPOSED NATURE RESERVE ZONE

The large, provincially significant, life science Nature Reserve Zone proposed within the park has been divided into five areas (Areas A to E) with different complexes of representative and significant features (See Figure 4 and Map 2). Because the Niagara Escarpment crosses through Areas A to D, the significant features of the escarpment will first be outlined in general. A discussion of the significant features of Areas A to E follows. The order of discussion does not imply a ranking of the five significant areas within the Nature Reserve Zone. They are all considered highly significant, integral parts of the large, provincially significant Nature Reserve Zone.

Niagara Escarpment

The exposure of the main face of the Niagara Escarpment and two dolostone outliers at Mono Cliffs is one of its outstanding geological, biological and scenic features. The escarpment complex is considered to include the following communities: 3) Bedrock Pavement Rim, 4) Cliffs, 5) Talus and Steep Bedrock Slopes, and also 1D) White Birch – Sugar Maple – Large-toothed Aspen forests associated with the western rim of the north and

Table 3: Ferns and Fern Allies of Mono Cliffs Provincial Park

Mono Cliffs is very well kinown for its diverse fern flora. It supports 44 of the 96 species of ferns and fern allies that grow in Ontario (Britton 1985, p. 2). A number of these species are restricted to specialized niches associated with the calcareous bedrock of the Niagara Escarpment. In the past decade there have been many field trips to Mono Cliffs by fern specialists, professional botanists, field naturalists, and students to study ferns and fern allies. It is unnecessary and illegal to pick or collect ferns or other plants in the park.

Britton (1981) provided some historical background to botanical research at Mono Cliffs in notes prepared for a field trip with the Canadian Botanical Association. "The famous and rare Hart's-Tongue Fern has been known in this valley since J.F. Calvert wrote in 1908 that he had seen 8 plants. By 1934, T.M.C. Taylor said there were hundreds. One should reflect that this species is rare and endangered in North America. The only region where there are good sized populations in all of North America is Grey County and southern Bruce County. Accordingly, it is hoped that the populations in this park will *not* be disturbed and will be here for posterity. The rich talus slopes are particularly sensitive to any traffic and should be avoided."

Species	**Common Name**	**Status**[1]
Lycopodium annotinum	Stiff Clubmoss	
Lycopodium clavatum	Running Clubmoss	
Lycopodium digitatum	Crowfoot Clubmoss	
Lycopodium lucidulum	Shining Clubmoss	
Lycopodium obscurum var. *obscurum*	Ground-pine	
Equisetum arvense	Field Horsetail	
Equisetum fluviatile	Water Horsetail	
Equisetum scirpoides	Dwarf Scouring-rush	L
Equisetum sylvaticum	Woodland Horsetail	
Equisetum variegatum	Variegated Scouring-rush	O
Botrychium dissectum		
f. *dissectum*	Dissected Grape Fern	
f. *obliquum*	Oblique Grape Fern	
Botrychium matricariifolium	Daisy-leaved Grape Fern	
Botrychium multifidum	Leather-leaved Grape Fern	
Botrychium rugulosum	Rugulose Grape Fern	NPR
Botrychium simplex var. *simplex*	Least Moonwort	
Botrychium virginianum	Rattlesnake Fern	
Ophioglossum vulgatum var. *pseudopodum*	Northern Adder's-tongue Fern	L
Osmunda cinnamomea	Cinnamon Fern	
Osmunda regalis var. *spectabilis*	American Royal Fern	
Pteridium aquilinum var. *latiusculum*	Eastern Bracken	
Adiantum pedatum	Northern Maidenhair Fern	
Cryptogramma stelleri	Slender Cliff-brake	L(E)
Pellaea glabella	Smooth Cliff-brake	L(E)
Asplenium trichomanes ssp. *quadrivalens*	Maidenhair Spleenwort	L(E)
Asplenium viride	Green Spleenwort	Rr
Athyrium felix-femina	Northeastern Lady Fern	
Athyrium thelypterioides	Silvery Glade Fern	
Camptosorus rhizophyllus	Walking Fern	r

Table 3: Ferns and Fern Allies of Mono Cliffs Provincial Park (cont'd)

Species	Common Name	Status[1]
Cystopteris bulbifera	Bulblet Fern	
Cystopteris tenuis var. *mackayi*	Mackay's Fragile Fern	
Dryopteris carthusiana	Spinulose Wood Fern	
Dryopteris clintoniana	Clinton's Wood Fern	
Dryopteris cristata	Crested Wood Fern	
Dryopteris intermedia	Glandular Wood Fern	
Dryopteris marginalis	Marginal Wood Fern	
Dryopteris X *boottii*	(*D. intermedia* X *D. cristata*)	
Dryopteris X *triploidea*	(*D. intermedia* X *D. carthusiana*)	
Dryopteris clintoniana X *D. intermedia*	Hybrid Wood Fern	
Dryopteris clintoniana X *D. marginalis*	Hybrid Wood Fern	
Gymnocarpium dryopteris	Oak Fern	
Matteuccia struthiopteris var. *pensylvanica*	American Ostrich Fern	
Onoclea sensibilis	Sensitive Fern	
Phyllitis scolopendrium	Hart's-tongue Fern	NPRr
Polystichum acrostichoides	Christmas Fern	L
Polystichum lonchitis	Holly Fern	r
Phegopteris connectilis	Northern Beech Fern	
Thelypteris palustris var. *pubescens*	Marsh Fern	
Polypodium virginianum	Rock Polypody	L(E)

[1] The following codes indicate the status of significant vascular plant species:

NP	Nationally and Provincially Rare (Argus *et al.* 1982-87; Argus and Pryer 1986)
R	Regionally Rare in Central Region (Riley 1989)
r	Restricted Geographically in Central Region (Riley 1989)
L	Locally Significant (Species restricted to escarpment-related niches (E), or found at only 1 or 2 locations in the park)
O	Other species of interest.

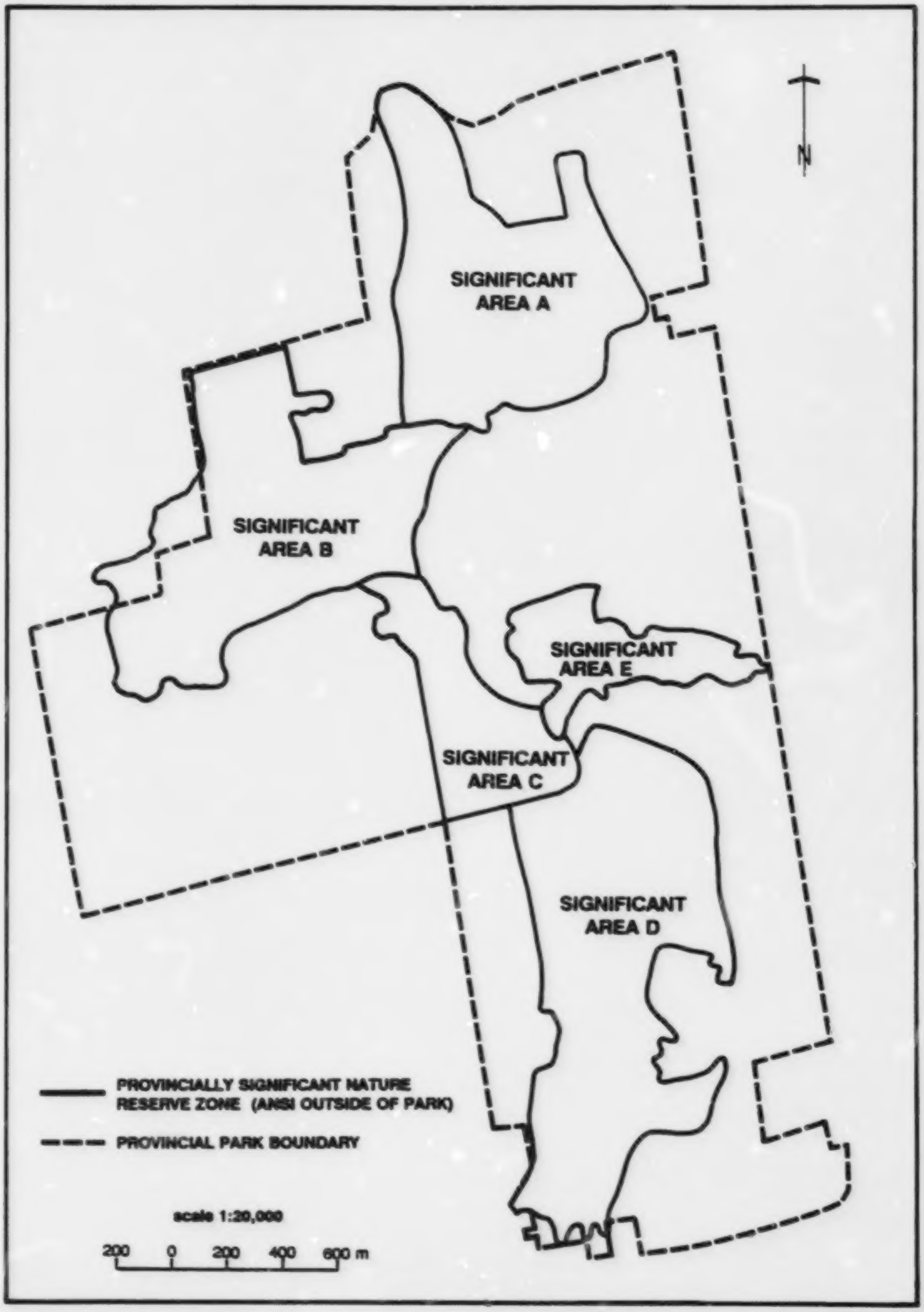

SIGNIFICANT AREA A
SIGNIFICANT AREA B
SIGNIFICANT AREA C
SIGNIFICANT AREA D
SIGNIFICANT AREA E
N
PROVINCIALLY SIGNIFICANT NATURE RESERVE ZONE (ANSI OUTSIDE OF PARK)
PROVINCIAL PARK BOUNDARY
scale 1:20,000
200 0 200 400 600 m

Figure 4: Significant Areas Within the Provincially Significant Nature Reserve Zone Proposed for Mono Cliffs Provincial Park

south outliers and occurring at several other small sites, and 2C) Sugar Maple – Eastern Hemlock – White Cedar mixed forests on mantled escarpment slopes. The deciduous forests extending back from the escarpment rim on the plateau, and the forests and wetlands along the base of the talus slope play a very important function in maintaining the quality of the escarpment features.

The old growth, White Cedar forests along the cliff-edge and cliff-face are certainly the oldest forests in the park and are part of an old growth forest community that extends along the length of the Niagara Escarpment. These White Cedar forests are considered to represent some of the oldest, most intact, old growth forests in eastern North America (Larson 1989, 1990, pers. comm.) There are over 6 km of cliffs in the park. The cliff-face fissure systems developed at eight locations in the park provide a specialized cool, moist, shaded environment which shelters a distinctive community of mosses, lichens, liverworts, ferns and associated species.

Excellent examples of both mixed and deciduous talus communities skirt the escarpment and its two outliers for over 8 km in the park. A wide variety of communities is found because of the range of exposures and site moisture conditions. The open Butternut-Basswood talus forests are significant as they are known elsewhere along the escarpment only from Rattlesnake Point and Mount Nemo (Varga pers. comm.).

Some of the significant species associated with the escarpment complex in the park are:

- The nationally and provincially rare, Hart's Tongue Fern (*Phyllitis scolopendrium*). The only region with substantial populations of this species in all of North America is Grey and Bruce Counties. Several hundred plants grow along three sections of the sensitive talus slopes in the park.
- The regionally rare, Green Spleenwort (*Asplenium viride*). Only six plants were located in an extremely sensitive, significant, cliff-face fissure system. Rock-cress (*Arabis hirsuta*), a regionally rare plant, grows on escarpment cliffs.
- Two geographically restricted species, Walking Fern (*Camptosorus rhizophyllous*) and Holly Fern (*Polystichum lonchitis*).
- The following locally significant, escarpment-related ferns: Maidenhair Spleenwort (*Asplenium trichomanes*), Slender Cliff-brake (*Cryptogramma stelleri*), Smooth Cliff-brake (*Pellaea glabella*), and Rock Polypody (*Polypodium virginianum*).

Significant Area A – North Escarpment and North Outlier

This area consists of the northernmost part of the provincially significant Nature Reserve Zone, from UTM 740782 north to 25 sideroad. The communities here are of a very fine quality, little disturbed by trails and offtrail use. The entire area has a wildness not found elsewhere in the park. White-tailed Deer were frequent here. Turkey Vultures and Red-tailed Hawks were always present during fieldwork in this part of the park. If these species do nest within the park, Area A is the most probable location.

There is excellent development of escarpment communities along the main face of the Niagara Escarpment and on the north outlier. The north outlier is completely forested and all aspects of rim, cliff and talus slope vegetation site types encircle it. This provides an excellent opportunity to study ecological processes effecting the development of escarpment communities. The escarpment and the north outlier are well protected by continuous deciduous forest and successional communities, extending back from the rim, and away from the base of the talus slope. The cliff-face fissure systems within Area A are in excellent condition. They represent the best quality, least disturbed, examples of this sensitive and significant feature in the park.

The mixed talus forests on the west and south-facing slopes of the north outlier are the only example of this type of talus community (White Birch – White Ash – White Cedar – Sugar Maple, 5B) growing in the park. The north outlier valley floor supports two forest stands dominated by Butternut (1E), the only stands of this type observed in the park, and a rich deciduous forest dominated by Sugar Maple (1A).

The great diversity of communities within Area A is increased by the wetland communities (mixed swamp, meadow marsh) along the spring-fed stream that rises at the north end of the north outlier and flows along its east side.

Some of the significant species found within Area A are:

- The nationally and provincially rare, Hart's Tongue Fern (*Phyllitis scolopendrium*), which grows on talus slopes of the main escarpment.
- The nationally and provincially rare, Ginseng (*Panax quinquefolium*). Two plants were observed during field work. It is hoped that this small population will set seed and expand.
- The nationally and provincially rare, Eastern Bluebird.
- Three geographically restricted species, Holly Fern (*Polystichum lonchitis*), Walking Fern (*Camptosorus rhizophyllous*) and Melic Grass (*Melica smithii*). Only two plants of Holly Fern were observed within the park.
- Six locally significant plant species: Juneberry (*Amelanchier spicata* var. *spicata*), Maidenhair Spleenwort (*Asplenium trichomanes*), Slender Cliff-brake (*Cryptogramma stelleri*), Great St. John's-wort (*Hypericum ascyron*), Smooth Cliff-brake (*Pellaea glabella*), Rock Polypody (*Polypodium virginianum*).
- Two other species of interest: Spotted Coral-root (*Corallorhiza maculata*) and Common Juniper (*Juniperus communis*).

Significant Area B – McCarston's Lake and Escarpment Re-entrant Valley

Deciduous forest completely surrounds McCarston's Lake, a kettle lake set in a depression in the steeply rolling moraine uplands west of the escarpment. The indentation in the escarpment along the stream flowing out of McCarston's Lake is a minor re-entrant valley. This whole re-entrant valley is completely forested, from the plateau above the escarpment to the large mixed swamp on the valley floor, and its forests are continuous with those around McCarston's Lake.

McCarston's Lake is the only natural lake in Mono Township. Its watershed and source areas are completely forested. Thus, this is a headwater unit remaining in natural vegetation cover. Because of its undisturbed condition, McCarston's Lake has been chosen for palynological research (McAndrews 1990). The analysis of lake sediments for "... fossil pollen, plant macrofossils, radiocarbon age, and geochemistry by loss-on-ignition" is being used to reconstruct the vegetation history at McCarston's Lake and to "... infer effects of climatic change and prehistoric and historic human impact on the vegetation." A recent study of the fauna of McCarston's Lake (Kott and MacRae-Mitchell 1990) determined that the lake was rich in molluscs and had high numbers of Painted Turtles.

The best developed, most extensive, system of cliff-face fissures in the park occurs along the escarpment re-entrant valley. The publication of the location of this site in the 1974 Master Plan attracted attention to it. The ensuing visitation damaged the carpets of moss, liverwort and ferns on the moist cliff-faces and compacted the loose organic soils and the fern flora on the floor of the crevices. In 1987, the outdoor education centres in the area agreed to keep groups away from this sensitive area. There has been a noticeable improvement, but site recovery to the condition observed by the author in 1974 will take a decade or more.

The locations of certain features and species (*i.e.* cliff-face fissures and kettle bog) and species (*i.e.* Jefferson Salamander and rare genera of protists) within Area B are not included in this report because of their significance and sensitivity. The locations are on file at the Central Region office of the Ministry of Natural Resources, Aurora.

The small kettle depressions on the moraine hold a variety of wetland vegetation types. Kettle wetlands are considered representative features of the landscape of Site District 6-7 in which Mono Cliffs is located (Lindsay 1984). Only one other example of a kettle bog feature occurs in Mono Township; another small kettle bog may occur at 41A/1 734755 on private land (Lindsay 1990, airphoto interpretation). Plant species restricted to the kettle bog in the park include: Leatherleaf (*Chaemaedaphne calyculata*), Creeping Snowberry (*Gaultheria hispidula*), Wintergreen (*Gaultheria procumbens*), Winterberry (*Ilex verticillata*), Labrador-tea (*Ledum groenlandicum*), Bog Buckbean (*Menyanthes trifoliata*), *Spaghnum palustre*, and the locally significant Witherod (*Viburnum cassinoides*).

The other small kettle ponds and all wetlands within this unit are also significant breeding habitat for amphibians. This is the northernmost known locality for 'pure' diploid *Ambystoma jeffersonianum* (Bogart 1991). Rare genera of protists have also been found in small kettle ponds within Area B (Lynn and Olson 1990).

A very small population (six plants) of the regionally rare, Green Spleenwort (*Asplenium viride*) grows within Area B. The only stand of Christmas Fern (*Polystichum acrostichoides*) in the park is found within Area B; a population estimated at 60 to 70 plants grows here.

The high hill (500 m. a.s.l.) covered with Amabel dolostone boulders, located in the hawthorn savanna northeast of McCarston's Lake offers a spectacular view of the park and surrounding landscape in all directions. Physical features can be clearly interpreted and related to vegetation patterns from this vantage point.

Significant Area C – Jacob's Ladder to Carriage Trail

The ecological values of the central part of the provincially significant Nature Reserve Zone, between Jacob's Ladder and the Carriage Trail, are high as are its sensitivities. Within this significant area are excellent examples of old growth cliff-edge and cliff-face forests, high exposed cliffs, a well-developed cliff-face fissure system and excellent examples of both mixed (White Cedar – White Birch) and rich deciduous (Sugar Maple – Butternut – Basswood – Yellow Birch) talus slope communities. The deciduous forests and fields with advanced regeneration above the escarpment and the wetlands and forests along the base of the talus slope are extremely important to the maintenance of the escarpment features. This area presently receives one of the highest levels of visitation in the entire park.

From the top of the escarpment, the Jacob's Ladder area offers superb views of the cliffs, the Jacob's Ladder feature, the two outliers, the spillway below the escarpment with its streams and ponds, and the landscape in the distance. The process of crevice formation can also be observed and interpreted in several places near the cliff rim. The open Butternut-Basswood forests found along sections of escarpment slope with steep, open, bouldery talus are highly significant as they are known elsewhere along the escarpment only from Rattlesnake Point and Mount Nemo (Varga pers. comm.) The wetlands within the significant area, the stream, the beaver pond, and the man-made ponds at the bottom of the slope augment further the ecological diversity of this area.

The following significant species are found within Area C:

- The nationally and provincially rare, Hart's-tongue Fern (*Phyllitis scolopendrium*), which grows on the deciduous talus slopes
- The geographically restricted, Walking Fern (*Camptosorus rhizophyllous*).
- Five locally significant species: Maidenhair Spleenwort (*Asplenium trichomanes*), Slender Cliff-brake (*Cryptogramma stelleri*), Dutchman's-breeches (*Dicentra cucullaria*), Canada Waterleaf (*Hydrophyllum canadense*) and Rock Polypody (*Polypodium virginianum*).

The level of use that the escarpment complex within Area C is receiving is clearly damaging its significant features. Trail use is so heavy above the escarpment near the rim, along the length of the Jacob's Ladder feature and to the south as well, that there is serious soil compaction and erosion and very little or no recruitment of seedlings. Rock climbing and scrambling on the cliff-faces and in the cliff-face fissure system is detrimental to these highly significant communities. Also of great concern are the many trails that have proliferated across the steep, easily eroded and highly significant talus slopes, and around the beaver pond in the last five years. Measures to control and direct use in this area and provide interpretative information, while allowing regeneration of the rest of the area, are recommended (Chapter III(vi)).

Significant Area D – South Escarpment, South Outlier Valley and South Outlier

This significant area is a large, continuously forested, landscape unit comprised of: the main escarpment face, the wetlands and mixed forests on the spillway floor in the south outlier valley, the escarpment complex encircling the south outlier, and deciduous and mixed forests on the plateau of the south outlier. Several areas of advanced natural regeneration are also included.

Excellent examples of old growth, cliff-face and cliff-edge forests are developed along the extensive exposures of high cliffs within this unit. Larson (1989) studied the old growth forest community on five transects along the exposed cliff-face within Area D and found White Cedars greater than 300 years in age (Larson pers. comm.). One extensive, undisturbed example of a cliff-face fissure system occurs within Significant Area D. There is also another excellent, extensive example within this area, which has unfortunately been damaged by overuse. Measures designed to allow this damaged cliff-face fissure system to regenerate and recover are suggested in the Recommendations (Chapter III(vi)).

Mixed talus forests (White Cedar – White Birch) and deciduous talus forests (Sugar Maple – Butternut – Basswood – Yellow Birch) are very well-developed along the talus slopes in Significant Area D. The open Butternut – Basswood forests found along sections of escarpment slope with steep, open, bouldery talus are highly significant as they are known elsewhere along the escarpment only from Rattlesnake Point and Mount Nemo (Varga pers. comm.).

The forest of White Birch – Sugar Maple – Large-toothed Aspen, which occupies a band along the western rim of the south outlier, is another interesting community. The Niagara Escarpment plain stand sampled by Varga in 1981, as part of a quantitative study of the Forests of the Niagara Escarpment, is located within this unit (Varga, pers. comm.). The same type of forest community is associated with the western edge of the north outlier, however the White Birch – Sugar Maple – Large-toothed Aspen forests along the rim of the south outlier are more mature. Another forest stand sampled by Varga in 1981 is located within Significant Area D. It is a Niagara Escarpment rim slope stand dominated by White Birch and Eastern Hemlock.

Mixed forest communities are particularly well-developed within Significant Area D. All of the six mixed forest communities identified and described within the park occur here. The wetlands at the north and south ends of the south outlier valley (mixed swamp, cattail and meadow marsh, stream and pond habitats) add to the diversity of habitats within Area D. These are fed by springs which rise in two zones along the main escarpment face.

The area is well known for its diverse fern flora. Dr. D.M. Britton, an expert on the ferns of Canada, commented on the fern flora of the south outlier valley (Britton, 1981, p. 1). "Another notable feature of this valley is the rich sand of the valley floor. Here one finds *Botrychiums* [Grapeferns] and *Lycopods* [Club-mosses] which are rare in southern Ontario." The ferns and fern allies of the south outlier valley have been the focus of a number of field trips organized for professional botanists and amateur naturalists, for example the Canadian Botanical Association, the American Institute for Biological Studies, the Canadian Nature Federation, the Federation of Ontario Naturalists, university groups and several naturalist clubs.

The significant species of Significant Area D include:

- Two nationally and provincially rare species, Rugulose Grape Fern (*Botrychium rugulosum*) and Hart's-tongue Fern (*Phyllitis scolopendrium*).
- The regionally rare, Rock-cress (*Arabis hirsuta*).
- The geographically restricted, Walking Fern (*Camptosorus rhizophyllous*).
- Eight locally significant plant species, Juneberry (*Amelanchier arborea*, *A. spicata* var. *spicata*), Maidenhair Spleenwort (*Asplenium trichomanes*), Slender Cliff-brake (*Cryptogramma stelleri*), Great St. John's-wort (*Hypericum ascyon*), Northern Adder's-tongue fern (*Ophioglossum vulgatum*), Smooth Cliff-brake (*Pellaea glabella*) and Rock Polypody (*Polypodium virginianum*).
- Five other plant species of interest: Spotted and Striped Coral-root (*Corallorhiza maculata*, *C. trifida*), Variegated Scouring-rush (*Equisetum variegatum*), Loesel's Twayblade (*Liparis loeselii*) and Nodding Ladies-tresses (*Spiranthes cernua*).
- Fry and fingerling Brook Trout have been observed along the branch of Sheldon Creek upstream to its spring source (Hood pers. comm.). Sections of stream which are major reproductive zones are highly significant and extremely important to the fish populations in Sheldon Creek (Imhof pers. comm.).
- Pickerel Frog, an uncommon but widespread species in Central Region.

Significant Area E – Sheldon Creek Valley

Significant Area E consists of the block of deciduous and mixed forest surrounding two branches of Sheldon Creek which join and flow through a large conifer swamp before reaching pond 10F. This section of Sheldon Creek is an excellent spawning and nursery area for Brook Trout (Hood pers. comm.). Sections of stream which are major reproductive zones are highly significant and extremely important to the fish populations in Sheldon Creek (Imhof, pers. comm.).

Two locally significant plants occur. These species were observed only at this location in the park. Dwarf scouring-rush (*Equisetum scirpoides*) grows along the banks of Sheldon Creek near a small waterfall. This waterfall location is also of geological significance as it shows the contact between Manitoulin dolostone and Whirlpool sandstone. Hobblebush (*Viburnum alnifolium*) is an addition for Wellington-Dufferin to Riley (1989).

(iv) OTHER SIGNIFICANT AREAS

Two other significant areas, outside of the contiguous, provincially significant Nature Reserve Zone are mapped on Map 2 and Figure 5. These should be considered for Nature Reserve Zone or Natural Environment Zone status in park management planning.

Other Significant Area a) Deciduous Forests, Woodlots and Regenerating Old Fields, West of the Escarpment and South of McCarston's Lake

This large area contains representative, good quality examples of deciduous forest and old fields in natural succession on the moraine above the escarpment. Significant species such as Eastern Bluebird and Cutleaf Toothwort (*Dentaria laciniata*) occur. Six large White Pine grow within this area, the only naturally seeded pine found in the natural forests of the park. A small stand of young White Pine is establishing itself in the old field adjacent to the large White Pine.

Other Significant Area b) Wetlands and Forested Slope West of 3rd line

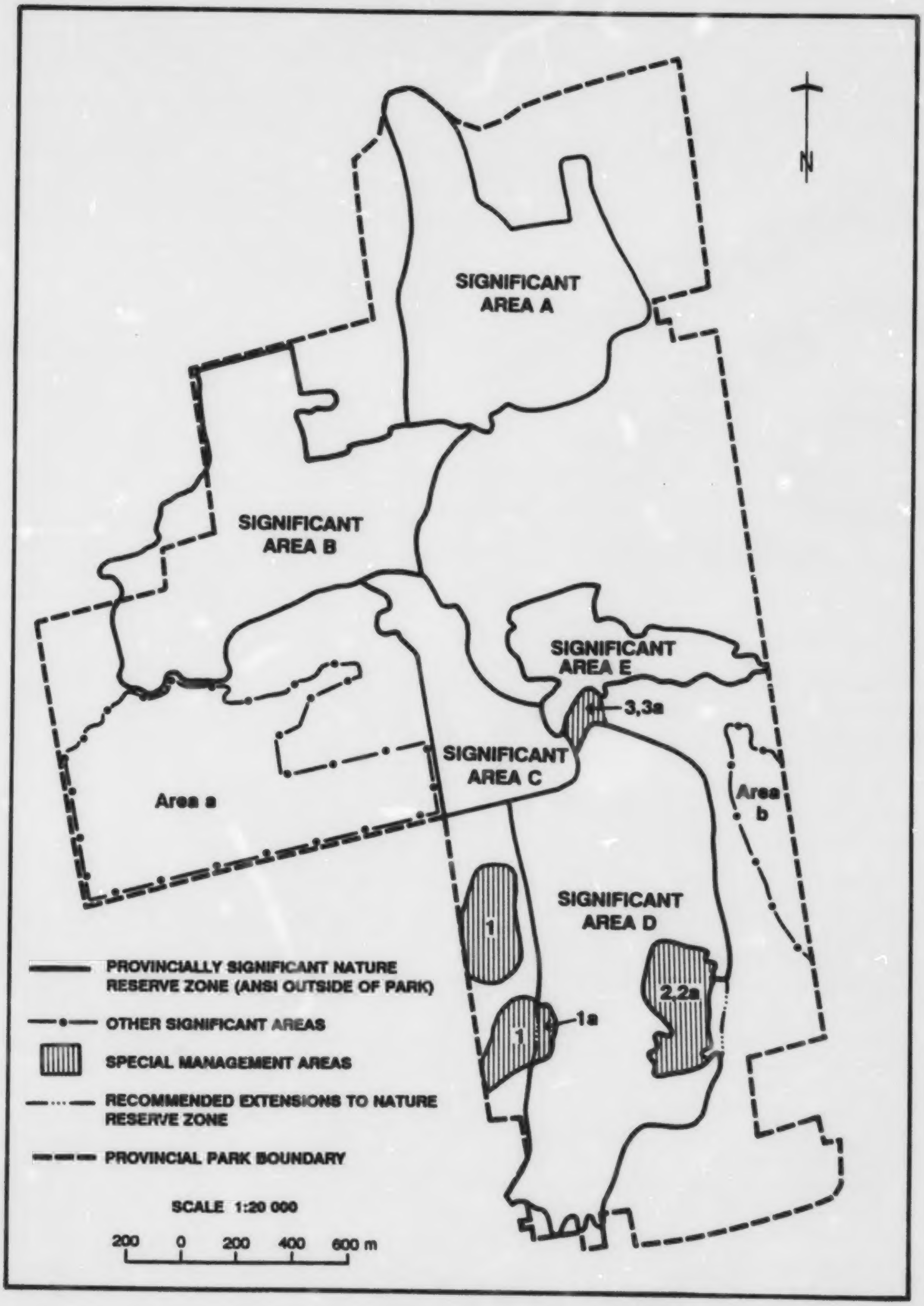
This large wetland, at the headwaters of a stream that flows south to the Nottawasaga River in the Hockley Valley, contains three wetland communities not found elsewhere in the park: mixed swamp (Tamarack – White Spruce – White Cedar – Balsam Fir – White Birch – Black Ash and White Cedar – White Birch – White Spruce) and shrub-rich marsh. The forested slope sheltering the west side of the wetland is in excellent condition. The significant species Golden Ragwort (*Senecio aureus*) was found here. This site presents educational and interpretive opportunities to study wetlands.

(v) SPECIAL MANAGEMENT AREAS (1 TO 3)

There are three areas of Scotch Pine plantation (community 13C) and old fields with self-seeded Scotch Pine (community 11C) in the south half of the park in which Scotch Pine must be removed as soon as possible. Refer to Map 2 and Figure 5. The concern is that the Scotch Pine in the park are producing seed and functioning as a weedy, introduced species. Many young, self-seeded, Scotch Pine are well established in certain old field and successional communities and are now producing seed themselves. After the Scotch Pine is removed from these areas, they should be left to regenerate naturally.

Recommended Extensions to the Nature Reserve Zone (1a, 2a and 3a)

Once the Scotch Pine is removed from three areas shown as 1a, 2a and 3a on Map 2 and Figure 5, these areas would make practical extensions to the large, provincially significant Nature Reserve Zone because of their location. The quality of natural regeneration already present in these two areas is excellent.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PROVINCIALLY SIGNIFICANT NATURE RESERVE ZONE (ANSI OUTSIDE OF PARK)
OTHER SIGNIFICANT AREAS
SPECIAL MANAGEMENT AREAS
RECOMMENDED EXTENSIONS TO NATURE RESERVE ZONE
PROVINCIAL PARK BOUNDARY
SCALE 1:20 000
200 0 200 400 600 m

Figure 5: Significant Areas and Special Management Areas of Mono Cliffs Provincial Park

(vi) RECOMMENDATIONS

Some very positive changes have occurred to the natural features of Mono Cliffs Provincial Park, since its acquisition in the 1960s. Its forests have matured, many fields have developed diverse, successional communities which complement these forests, and the removal of grazing from forests and talus slopes has probably increased the frequency of fern and moss communities. At the same time, the park has become very well known to naturalists, scientists, educators and the general public. The park receives a high level of day use, and much of this use occurs in the winter, spring and fall seasons when the natural habitats and trails in the park are most susceptible to damage.

Serious environmental problems have developed at Mono Cliffs in the 18 years since the first ecological assessment of the park and the author's first field studies there (Cuddy 1973, Lindsay 1973). Many areas of the park are showing the effects of a high level of recreational use, particularly certain sensitive and highly significant escarpment communities (rim, cliff, cliff-face fissure systems and talus slopes) and certain sections of the official trail system. The proliferation of unofficial trails in the park is also of great concern. In the last five years, the environmental stress resulting from increased and uncontrolled visitation to the park has accelerated.

Recommendations for park management planning, based on the analysis of ecological information assembled during this study, are presented below. More detailed recommendations (26 July 1990) are on file at the Central Region and Huronia District Offices. These present additional detail, especially for significant areas and features which have been damaged by recreational use. Measures designed to control and direct use, and allow regeneration and recovery, were presented for the following areas: 1) the escarpment complex in the Jacob's Ladder area, 2) three cliff-face fissure systems, 3) the unofficial trails observed in sensitive and significant areas during this inventory, and 4) wetland areas and stream crossings along the official trail system maintained and marked by the ministry (Ontario Ministry of Natural Resources 1988), which require boardwalk or log crossings to remedy trail widening and damage to adjacent habitats.

In the next decade, there will probably be only modest chances to increase the staff and management funds available to maintain the important heritage resources at Mono Cliffs. All management plan recommendations should consider the impacts of 25 to 50 years of continuing expansion of use and impact, with only modest management resources likely. The protection of the natural features of the park must be aggressively dealt with in the management planning of the park. The management plan must lay out concrete, practical, longterm solutions which avoid half-measures and key on the longterm protection of the provincially significant life and earth science features of the park.

Park Zoning and Classification

1. All of the escarpment face, the forests around McCarston's Lake, the two outliers, the wooded outlier valleys, and the forests and wetlands along Sheldon Creek should be zoned Nature Reserve. The recommended boundary of the area proposed as Nature Reserve is mapped on Maps 1 and 2 and shown on Figures 4 and 5. This area is referred to as the large, provincially significant Nature Reserve Zone in Chapter III, sections (ii) to (v). The Ontario Provincial Parks Planning and Management Guidelines for Nature Reserves (1978) would apply.

2. Two other significant areas, outside the provincially significant Nature Reserve Zone, should be considered for Nature Reserve or Natural Environment Zone status during park management planning. These significant areas, shown on Map 2 and Figure 5, should be managed in a way that ensures the maintenance of their representative and special features. Area a) consists of the deciduous forests, woodlots and regenerating old fields west of the escarpment and south of McCarston's lake. Area b) includes the wetlands and forested slope west of the 3rd line.

3. A park classification of Nature Reserve should be considered for Mono Cliffs Provincial Park. Currently the park is classed as Natural Environment. The Nature Reserve Zone proposed for life science features covers 299 ha or 41 percent of the park area. The provincially significant life science features are largely coincident with the provincially significant earth science zones identified by Kor (1991). A park classifica-

tion of Nature Reserve would recognize and offer protection for the provincially significant life and earth science features at Mono Cliffs, while providing opportunities for interpretation and education.

Mono Cliffs offers outstanding representation of Niagara Escarpment features. It is the only major exposure of the Niagara Escarpment along its central section, between Credit Forks and Lavender Falls. More than 8 km of escarpment habitats are exposed along the escarpment face and around two dolostone outliers.

There are only two provincial Nature Reserves along the southern half of the Niagara Escarpment – Hockley Valley (also known as Scott's Falls and Cannings Falls) and Noisy River Valley (Lavender Falls). Both are small river valleys incised into escarpment bedrock, with limited representation of escarpment features. There are seven provincial Nature Reserves along the entire length of the Niagara Escarpment, from Tobermory to Niagara Falls, but none represent the Niagara Escarpment itself in the southern half of the escarpment.

Significant Area A

4. Trail development and use should continue to be directed away from all of Significant Area A, the North Escarpment and North Outlier, which is the northern part of the provincially significant Nature Reserve Zone, shown on Map 2 and Figures 4 and 5. The communities here are very well developed and are of a very fine quality, little disturbed by trails and off-trail use. The entire area has wildness not found elsewhere in the park. Its value for scientific research is very high. The ministry has not developed trails in this area and, as a result, it has been protected to a large degree from the environmental damage and disturbance caused to the rest of the park by increased use over the past two decades.

Areas with Extreme Environmental Constraints

5. Site-specific developments (*e.g.* trails) and ongoing use activities (*e.g.* outdoor education activities) should be kept away from areas with extreme environmental constraints and highly significant and sensitive communities. A qualified biologist should conduct an environmental analysis of each development proposed in extreme constraint areas, or anywhere within the provincially significant Nature Reserve Zone, before a decision to proceed with the development is made. Within the park, areas with extreme constraints to development and highly sensitive and significant communities include: the escarpment complex comprised of the thinly-soiled bedrock pavement at the escarpment rim and on the plateau behind it, the cliffs, the cliff-face fissure systems and the talus slopes; all the wetlands including the conifer and mixed swamps, the bog and the marshes; McCarston's Lake, its shoreline and the slopes around its shoreline; the streams and the springs and seepage areas that feed them; and the ponds and their shorelines and banks (See Maps 1 and 2).

6. The cliff-face fissure systems developed at eight locations along the escarpment and outlier cliff-faces in the park are ecologically important and sensitive to even low levels of visitation. None of the cliff-face crevice systems should be allowed to deteriorate or be accessed by trails. Even small amounts of foot traffic in these areas destroy the mats of mosses, liverworts and ferns growing on the moist, rock faces and loose organic soil on the crevice floor.

   Three of the best developed cliff-face fissure systems in the park have been damaged by a high level of visitation. These areas should be given an opportunity to restore themselves. In general, the measures suggested to allow the recovery of these highly sensitive areas include: closing these fissure systems to park visitors and supervised groups, blocking the trails leading to them, erecting signs explaining that the fissure systems are closed for regeneration, communicating with the groups which have used these areas in the past, and monitoring the closure of these fissure systems and their recovery.

Significant Area C (Jacob's Ladder Area)

7. Measures to control and direct use are required in the Jacob's Ladder area of the park. The level of use that the escarpment complex within Area C is receiving is clearly damaging its significant features. Trail use is so heavy above the escarpment near the rim, along the length of the Jacob's Ladder feature and to the south as well, that there is serious soil compaction and erosion and very little or no recruitment of seedlings. Rock climbing and scrambling on the cliff-faces and in the cliff-face fissure system is detrimental to these highly significant communities. Also of great concern are the many trails that have proliferated across the steep, easily eroded and highly significant talus slopes, and around the beaver pond in the last five years.

Considerations for Management Planning

8. During management planning, consideration should be given to moving access points and car parking areas away from the provincially significant Nature Reserve Zone. Locations on the eastern boundary of the park should be considered preferable to present arrangements. The first park master plan (Ontario Ministry of Natural Resources 1974) called for all access roads and car parking areas to be located away from important ecological areas, away from the centre of the park and also to be screened from vantage points. These principles are still very valid. The location of parking areas and access points can help protect significant and sensitive features by directing park use into areas with the capacity to handle it.

   The existing parking area on the 2nd line at the north end of the park should be closed as soon as possible. Then the 2nd line could be closed to vehicular traffic, from the parking area north to where the park boundary crosses the 2nd line, or to 25 sideroad. This parking area makes access too easy to the best developed, most extensive system of cliff-face fissures in the park. Over the last 18 years, since the first ecological assessment of the park area, the sensitive plant communities here have deteriorated dramatically. Even a small amount of foot traffic destroys the mats of mosses, liverworts and ferns growing in these moist, shaded ravines. Keeping people away from this sensitive habitat will allow the site to recover.

   The south parking area on the 2nd line should also be moved, once a location for access and car parking has been found on the eastern side of the park. This parking area brings concentrations of visitors too close to the provincially significant Nature Reserve Zone. The level of use that the escarpment complex adjacent to this parking area, within Significant Area C, is receiving is clearly damaging its significant features.

9. The ministry must establish guidelines for the types of use permitted in the provincially significant Nature Reserve Zone. Appropriate types of use in the Nature Reserve Zone would be those considered permitted uses for Nature Reserves in the Ontario Provincial Park Planning and Management Guidelines (1978), for example, hiking, nature appreciation, photography, cross-country skiing and snowshoeing.

   A wide range of activities were observed within the provincially significant Nature Reserve Zone during fieldwork in 1989, 1990 and 1991: angling, camping, cliff climbing and scrambling, cycling (and mountain bike riding), horseback riding, hunting with slingshots, llama trekking, orienteering, picking wildflowers, motorized trail bike riding and snowmobiling. Taken together, these activities have a detrimental impact on the provincially significant biological features of the park, and should be reviewed during the management planning process. Certain activities such as horseback riding, mountain bike riding, motorized trail bike riding and snowmobiling can also present hazards to other park visitors using the trail system.

   The ministry should continue to seek ways to communicate the types of uses that are appropriate, and those that are not, to park visitors and organized groups. Recent publications such as "Mono Cliffs Hiking Trails" and "User's Guide for Mono Cliffs Provincial Park" (Ontario Ministry of Natural Resources 1988), and the "Mono Cliffs Provincial Park Teacher's Guide" (Frost 1991), will help to establish appropriate types of park use. So will the new signs erected in 1990 by the ministry in the Jacob's Ladder area and in the south outlier valley detailing prohibitions on risk activities, such as rock climbing.

If the ministry decides to allow certain other uses in the park, that are not considered appropriate within the provincially significant Nature Reserve Zone, these could be planned for other areas of the park. For example, the development of a trail for mountain bike riding or horseback riding along the eastern side of the park would pose few environmental problems, and the scenery and terrain would be spectacular.

10. There is a need for a core park staff, based at the park, to provide direction for and supervision of visitors and groups, surveillance of park use, enforcement of park policies, liaison with different outdoor education groups using the park, and ongoing park operation and management. Mono Cliffs Provincial Park is currently managed from Earl Rowe Provincial Park. Staff work part-time at Mono Cliffs under the direction of the Park Superintendent for Earl Rowe.

    Once there is park staff based at the park, it will be easier to implement measures to help protect the significant biological and geological resources of the park. The high level of year-round use that this area receives, both through the week and on week-ends, has caused environmental degradation of certain sensitive and significant features, even though much of the use is well intentioned from an environmental point of view.

11. Camp McGovern, a private campground run by the Big Brothers Association of Kitchener-Waterloo, should be phased out of the park when its agreement with the ministry expires in 2003, because of the impact of its activities on the highly significant escarpment complex along the northeast side of the south outlier.

Special Management Areas

12. Scotch Pine is an aggressive, alien species which is spreading rapidly through the park. The Scotch Pine growing in three areas of the park must be removed as soon as possible. These areas of Scotch Pine plantation and old fields with many young, self-seeded Scotch Pine are mapped as Special Management Areas 1, 2 and 3 on Figure 5 and Map 2. Scotch Pine in the park are producing seed and functioning as weedy, introduced species. After the Scotch Pine is removed from these areas, they should be left to regenerate naturally. The occasional Scotch Pine that are established in other locations, scattered around the park, should also be removed.

    One way to accomplish the removal of the Scotch Pine in Special Management Areas 1, 2 and 3 might be a co-operative project with the Outdoor Education Centres, involving students visiting the park in the removal of Scotch Pine, under the direction and supervision of ministry staff. Studies of tree identification and growth, seed dispersal, native and weedy plants and forestry techniques could be related to the project.

    After the Scotch Pine is removed from three areas shown as 1a, 2a and 3a on Figure 5 and Map 2, these areas would make practical extensions to the large provincially significant Nature Reserve Zone because of their location and the quality of natural regeneration already present.

    The Norway Maple located on the terrace on the east side of the south outlier, at UTM 750767, should also be removed. Norway Maple is another weedy, introduced species that reproduces vigorously and invades natural communities.

Trails

13. The official system of trails provides good access to most of the significant and scenic features of the park. Six trails form the official trail network – the Bruce Trail, Cliff Top Trail, McCarston's Lake Trail, Carriage Trail, Spillway South Outlier Trail and Spillway Trail (Ontario Ministry of Natural Resources 1988). The development of any new official trails in areas of low sensitivity should be linked to the closing of problem trails in sensitive areas, especially near the escarpment. Trails in addition to the official trail network include those of the Mono Cliffs Outdoor Education Centre, developed for cross-country skiing, snowshoeing and outdoor education activities within the park, in the fields and forests on the

moraine uplands west of the Niagara Escarpment. The locations of some of these trails were mapped by Lindsay (1988).

Numerous unofficial trails have developed in the park. Many of these lead to or cross sensitive and significant areas and have had a damaging impact. To counteract the proliferation of trails within the park, park visitors and leaders of groups visiting the park must be encouraged to stay on the official trail system, especially in the provincially significant Nature Reserve Zone. Leaders of groups must also be informed of the ministry's efforts to close trails in areas where they should not have been developed, where trails have damaged the park's environment or are hazardous, or where trails lead to or cross features that require protection.

14. A section of the McCarston's Lake Trail and main Bruce Trail near the critical headwaters of McCarston's Lake should be moved. There are many highly significant and sensitive features in the kettle wetlands west and southwest of McCarston's Lake. The present route of the McCarston's Lake Trail and the main Bruce Trail west and southwest of McCarston's Lake brings visitors too close to these features. Increased use, especially winter use, of the McCarston's Lake Trail and the Bruce Trail, over the past five years, since 1986, has resulted in serious soil compaction, trail widening, and erosion exposing tree roots on the very steep slopes west of McCarston's Lake. The author searched for an alternate route for the trail in this location in 1990.

15. The section of the Cliff Top Trail which runs between Jacob's Ladder and the Carriage Trail should be closed because of the problems of overuse, soil compaction and lack of regeneration that this area is experiencing. These problems are especially pronounced in along the section of the trail that extends south from Jacob's Ladder for about 300 m, across thinly-soiled escarpment rim habitats. Park visitors could be encouraged to follow the main Bruce Trail (*i.e.* the closed portion of the 2nd line) instead in this area, through the use of signs explaining that the area is closed for regeneration, and through the use of a rail fence marking the route of the trail.

16. The trail system in the park should continue to be monitored for impacts on significant and sensitive habitats and signs of excessive wear. There are other locations where trails traverse thinly-soiled escarpment rim communities in the park. Larson (1990) studied the effects of hiking and climbing disturbance in the old growth White Cedar forests at the escarpment rim. He observed an almost total absence of seedlings in disturbed areas, and concluded that, "The disturbed parts of the cliff-edge ecosystem are therefore not self-sustaining, and this has considerable significance in view of the great age shown by many of the trees." Given the findings of Larson (1990), it may be desirable to change the trail routing in at least some of these locations, before the problems of soil compaction and lack of regeneration become too great. Furthermore, some of the sandy slopes on the trails developed by the Mono Cliffs Outdoor Education Centre in 1986 were eroding after just one year of use (Lindsay 1988).

Land Purchases and Agreements

17. Consideration should be given to additional land purchases and/or agreements west of McCarston's Lake, in the back parts of lots 23 and 24, west half, concession II, to allow the re-routing of a section of the McCarston's Lake Trail and Bruce Trail to a location west of the critical headwaters of McCarston's Lake and the highly significant and sensitive features in this area. See recommendation 14.

18. Consideration should be given to additional land purchases and/or agreements in the 2nd concession to allow the closure of the 2nd line, north to 25 sideroad and south to the southern boundary of the Mono Cliffs Outdoor Education Centre property, to afford better protection for escarpment features within the provincially significant Nature Reserve Zone.

Park Operational Concerns

19. There is a need for proper fencing around the perimeter of the park to prevent access by vehicles. Much of the park is fenced with page wire fence; however there are breaks in the fence where motorized vehicles gain access, particularly on the western boundary of the park, along the 1st line. Stiles or walk-throughs in a zigzag formation could be used to control access by motorcycles, off-road vehicles and horses.

20. Very clear signs should be erected in highly visible locations around the perimeter of the park, and at any parking lots, to identify the park and state its hours of operation, the types of activities permitted and the activities that are not allowed.

21. Proper fences should be maintained around Nature Reserve Zone lands and all natural woodland and wetland areas on lands leased for grazing.

22. The deep fissure cave within the park should be gated because of its great significance and sensitivity and especially because of the dangers of this site.

23. The ministry should encourage large groups to notify the park superintendent as to when they will visit the park, and what areas and activities will be used. This would allow the ministry to direct groups to areas appropriate for their planned activities, to communicate basic information about the park, and to monitor and control types and levels of use that different areas of the park receive.

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APPENDIX A: VASCULAR PLANTS OF MONO CLIFFS PROVINCIAL PARK

A total of 470 species (475 taxa) of vascular plants have been recorded from Mono Cliffs Provincial Park. Of these, 44 species (49 taxa) are ferns and fern allies, representing 9.4% of the total flora. The main sources of records are: observations by the author, during fieldwork for this inventory (Lindsay 1991), during a floristic study of the Mono Rocks area (Lindsay 1973) and observations during the period 1973 to 1991; observations by Dr. D.M. Britton, an expert on the ferns and fern allies of Canada (Britton 1981, pers. comm.); and observations by Cuddy (1973a,b) who conducted the first ecological assessment of the park. Listed separately at the end of this checklist are an additional 11 species which have been reported from the park, but which require confirmation.

The nomenclature and taxonomic arrangement of this list follows Riley (1989). The following annotations in the left margin indicate the status of significant plants.

NP	Nationally and provincially rare (Argus *et al.* 1982-87).
R	Regionally rare in Central Region (Riley 1989).
r	Restricted geographically in Central Region (Riley 1989).
L	Locally significant. Species restricted to escarpment-related niches or found at only one or two locations in the park. Any native species which was an addition for Wellington-Dufferin in Riley (1989) was also considered to be locally significant.
O	Other species of interest

Introduced species or species adventive from cultivation are denoted by a "+" symbol in the left margin. A total of 107 species or 22.8% of the total flora are regarded as introduced or adventive from cultivation.

The numbers in the column, Community Number, refer to the vegetation communities described in Ch. II ii) and mapped on Map 1. The acronyms under Source refer to the observers listed below. Taxa represented by voucher specimens are indicated with an asterisk "*".

DB	Dr. Donald Britton (Britton 1981, pers. comm.)
DC	Don Cuddy (Cuddy 1973a,b)
KL	K.M. Lindsay. All specimens collected during this biological inventory (Lindsay 1991) and between 1973 and 1991 will be deposited in the herbarium of the Royal Ontario Museum (TRT).
JR	John Riley (Regional Ecologist, Central Region, Ontario Ministry of Natural Resources)
JV	Janet Versneu. This specimen is at OAC.

	Species	Common Name	Community Number	Source
	LYCOPODIACEAE	CLUBMOSS FAMILY		
	Lycopodium annotinum L.	Stiff Clubmoss		DB
	Lycopodium clavatum L. (typ.)	Running Clubmoss	2	KL*,DB
	Lycopodium digitatum A.Br. (*L. complanatum* L. var. *flabelliforme* Fern.)	Crowfoot Clubmoss	2,11	KL*,DB,DC
	Lycopodium lucidulum Michx.	Shining Clubmoss	2,5,6	KL*,DB,DC
	Lycopodium obscurum L. var. *obscurum*	Ground-pine	1,2	KL*,DB,DC
	EQUISETACEAE	HORSETAIL FAMILY		
	Equisetum arvense L.	Field Horsetail	1,2,6,9,11	KL*,DB,DC
	Equisetum fluviatile L.	Water Horsetail	6,9,10	KL*,DB,DC
L	*Equisetum scirpoides* Michx.	Dwarf Scouring-rush	1A	KL*,DC
	Equisetum sylvaticum L.	Woodland Horsetail	1	KL*,DC
O	*Equisetum variegatum* Schleich.	Variegated Scouring-rush	10K	KL*,DB,DC
	OPHIOGLOSSACEAE	ADDER'S-TONGUE FAMILY		
	Botrychium dissectum Spreng.			
	f. *dissectum* (*B. dissectum* Spreng. var. *dissectum*)	Dissected Grape Fern	1,2	DB,KL
	f. *obliquum* (Muhl.) Fern. (*B. dissectum* Spreng. var. *obliquum* (Muhl.) Clute)	Oblique Grape Fern	1,2	DB,KL
	Botrychium matricariifolium A. Br. *ex* Koch	Daisy-leaved Grape Fern	5	DB
	Botrychium multifidum (Gmel.) Rupr.	Leather-leaved Grape Fern		DB
NPR	*Botrychium rugulosum* Wagner (B. ternatum (Thunb.) Sw.)	Rugulose Grape Fern	13A	JV*

	Species	Common Name	Community Number	Source
	Botrychium simplex E. Hitch. var. *simplex*	Least Moonwort		DB
	Botrychium virginianum (L.) Sw.	Rattlesnake Fern	1,2,5	KL*,DB,DC
L	*Ophioglossum vulgatum* L. var. *pseudopodum* (Blake) Farw. (*O. pusillum* Raf.)	Northern Adder's-tongue Fern	11B	KL,DB
	OSMUNDACEAE	ROYAL FERN FAMILY		
	Osmunda cinnamomea L.	Cinnamon Fern	6,8	KL,DB,DC
	Osmunda regalis L. var. *spectabilis* (Willd.) Gray	Royal Fern	6,8	KL,DC
	DENNSTAEDTIACEAE	BRACKEN FAMILY		
	Pteridium aquilinum (L.) Kuhn var. *latiusculum* (Desv.) Underw.	Eastern Bracken	1,2,3,11	KL*,DB,DC
	ADIANTACEAE	MAIDENHAIR FERN FAMILY		
	Adiantum pedatum L.	Northern Maidenhair Fern	1,5	KL*,DB,DC
L	*Cryptogramma stelleri* (Gmel.) Prantl	Slender Cliff-brake	4	KL*,DB,DC
	Pellaea glabella Mett. *ex* Kuhn (*P. atropurpurea* (L.) Link var. *bushii* Mack.)	Smooth Cliff-brake	4	KL*,DB,DC
	ASPLENIACEAE	SPLEENWORT FAMILY		
	Asplenium trichomanes L. ssp. *quadrivalens* D.E. Meyer *emend.* Lovis	Maidenhair Spleenwort	3,4,5	KL*,DB,DC
Rr	*Asplenium viride* Huds.	Green Spleenwort	4C	KL*,DC
	Athyrium filix-femina (L.) Roth var. *michauxii* (Spreng.) Farw. (*A. angustum* (Willd.) Presl. var. *angustum*)	Northeastern Lady Fern	1,2,5,6	KL*,DB,DC
	Athyrium thelypterioides (Michx.) Desv.	Silvery Glade Fern	1,2	KL*,DB

Species	Common Name	Community Number	Source
r *Camptosorus rhizophyllus* (L.) Link (*Asplenium rhizophyllum* L.)	Walking Fern	4,5	KL*,DB,DC
Cystopteris bulbifera (L.) Bernh.	Bulblet Fern	4,5,6	KL*,DB,DC
Cystopteris tenuis (Michx.) Desv. (*C. fragilis* (L.) Bernh. var. *mackayi* Lawson)	Mackay's Fragile Fern	4,5,6	DB
Dryopteris carthusiana (Vill.) H.P. Fuchs (*D. spinulosa* (O.F. Muell.) Watt; *D. austriaca* (Jacq.) Woynar var. *spinulosa* (O.F. Muell.) Fiori)	Spinulose Wood Fern	1,2,6	KL*,DB,DC
Dryopteris clintoniana (D.C. Eat.) Dowell (*D. cristata* (L.) Gray var. *clintoniana* (D.C. Eat.) Underw.)	Clinton's Wood Fern		DB
Dryopteris cristata (L.) Gray	Crested Wood Fern	2,6	KL*,DB,DC
Dryopteris intermedia (Willd.) Gray (*D. spinulosa* (O.F. Muell.) Watt. var. *intermedia* (Willd.) Underw.) (*D. austriaca* (Jacq.) Woynar var. *intermedia* (Willd.) Mort.)	Glandular Wood Fern	1,2,3,4,5	KL*,DB,DC
Dryopteris marginalis (L.) Gray	Marginal Wood Fern	1,2,3,4,5,6	KL*,DB,DC
* *Dryopteris* X *boottii* (Tuckerm.) Underw.	(*D. intermedia* X *D. cristata*)		DB

	Species	Common Name	Community Number	Source
*	*Dryopteris* X *triploidea* Wherry (*D. austriaca* (Jacq.) Woynar var. *fructuosa* (Gilb.) Mort.) (*D. spinulosa* (O.F. Muell.) Watt. var. *fructuosa* (Gilb.) Trud.)	(*D. intermedia* X *D.carthusiana*)		DB
*	*Dryopteris clintoniana* X *D. intermedia*			DB
*	*Dryopteris clintoniana* X *D. marginalis*			DB
	Gymnocarpium dryopteris (L.) Newm. (*Dryopteris disjuncta* (Ledeb.) Mort.)	Oak Fern	2,5	KL*,DB,DC
	Matteuccia struthiopteris (L.) Todaro var. *pensylvanica* (Willd.) Mort. (*Pteretis pensylvanica* (Willd.) Fern.)	American Ostrich Fern	5,13	KL*,DB,DC
	Onoclea sensibilis L.	Sensitive Fern	2,6,8,9	KL*,DB,DC
NPRr	*Phyllitis scolopendrium* (L.) Newm. var. *americana* Fern.	Hart's-tongue Fern	5C,D	KL*,DB,DC
L	*Polystichum acrostichoides* (Michx.) Schott	Christmas Fern	1A	KL*,DC
r	*Polystichum lonchitis* (L.) Roth	Holly Fern	5A	KL*
	THELYPTERIDACEAE	BEECH FERN FAMILY		
	Phegopteris connectilis (Michx.) Watt (*Dryopteris phegopteris* (L.) Christens., *Thelypteris phegopteris* (L.) Slosson)	Northern, Narrow or Long Beech Fern	2	KL*

	Species	Common Name	Community Number	Source
	Thelypteris palustris (Salisb.) Schott var. *pubescens* (Lawson) Fern. (*Dryopteris thelypteris* (L.) Gray var. *pubescens* (Lawson) Nakai)	Marsh Fern	6,8,9	KL*,DC
	POLYPODIACEAE	POLYPODY FAMILY		
L	*Polypodium virginianum* L. (*P. vulgare* L. var. *virginianum* (L.) A.A.Eat.)	Rock Polypody	3,4,5	KL*,DB,DC
	TAXACEAE	YEW FAMILY		
	Taxus canadensis Marsh.	Canada Yew	2,3,5,6	KL*,DC
	PINACEAE	PINE FAMILY		
	Abies balsamea (L.)Mill.	Balsam Fir	1,2,3,5,6	KL*,DC
	Larix laricina (Du Roi) K. Koch	Tamarack	6	KL,DC
+	*Picea abies* (L.) Karst.	Norway Spruce	11	KL*,DC
	Picea glauca (Moench) Voss	White Spruce	1,2,6,8,11,13	KL*,DC
+	*Pinus banksiana* Lam.	Jack Pine	11,13	KL
	Pinus resinosa Ait.	Red Pine	2,13	KL,DC
	Pinus strobus L.	White Pine	1,2,11,13	KL*,DC
+	*Pinus sylvestris* L.	Scotch Pine	11,13	KL*,DC
	Tsuga canadensis (L.) Carr.	Eastern Hemlock	1,2,3,5,6,8	KL*,DC
	CUPRESSACEAE	CYPRESS FAMILY		
O	*Juniperus communis* L. var. *depressa* Pursh	Common Juniper	1D,11B	KL*
	Thuja occidentalis L.	White Cedar	2,3,4,5,6,7,11,12	KL*,DC
	TYPHACEAE	CATTAIL FAMILY		
	Typha angustifolia L.	Narrow-leaved Cattail	9	KL*

	Species	Common Name	Community Number	Source
	Typha latifolia L.	Common Cattail	6,9	KL,DC
	SPARGANIACEAE	BUR-REED FAMILY		
	Sparganium chlorocarpum Rydb.	Green-fruited Bur-reed	9A	KL*
	ZOSTERACEAE	PONDWEED FAMILY		
	Potamogeton natans L.	Floating Pondweed	10	KL*
	NAJADACEAE	NAIAD FAMILY		
	Najas flexilis (Willd.) R. & S.	Bushy Naiad	10	KL*
	ALISMATACEAE	WATER-PLANTAIN FAMILY		
	Alisma plantago-aquatica L. (incl. *A. triviale* Pursh and *A. subcordatum* Raf.)	Water-plantain	9,10	KL*,DC
	Sagittaria latifolia Willd.	Common Arrowhead	9	KL*,DC
	POACEAE	GRASS FAMILY		
+	*Agropyron repens* (L.) Beauv.	Quack Grass	11	KL*,DC
+	*Agrostis gigantea* Roth (*A. alba auct. amer., non* L.)	Redtop	11	KL*
	Agrostis perennans (Walt.) Tuckerm.	Autumn or Upland Bent Grass	1	KL*
	Agrostis scabra Willd., (*A. hyemalis* (Walt.) BSP. var. *tenuis* (Tuckerm.) Gl.)	Ticklegrass		DC
(+)	*Agrostis stolonifera* L. (*A. alba* L. var. *palustris* (Huds.) Pers.)	Creeping Bent Grass	11	KL*,DC
+	*Bromus inermis* Leyss.	Smooth Brome Grass	11,12	KL*,DC
	Calamagrostis canadensis (Michx.) Beauv.	Canada Blue-joint	6,9	KL*,DC
	Cinna latifolia (Goepp.) Griseb.	Nodding Wood Grass	5	KL*

	Species	Common Name	Community Number	Source
+	*Dactylis glomerata* L.	Orchard Grass	11,12	KL*
	Danthonia spicata (L.) R.&S.	Poverty Oat Grass	1,2,4,11,12	KL*
	Elymus hystrix L.	Bottle-brush Grass		DC
	Elymus virginicus L.	Virginia Wild-rye	11	KL*
	Glyceria grandis S. Wats.	Tall Manna Grass	9	KL*
	Glyceria striata (Lam.) A.S. Hitchc.	Fowl Manna Grass	6	KL*,DC
	Hierochloe odorata (L.) Beauv.	Sweet Grass		DC
	Leersia oryzoides (L.) Sw.	Cut Grass	6,9	KL*,DC
r	*Melica smithii* (A. Gray) Vasey	Melic Grass	1E,5D	KL*
	Muhlenbergia mexicana (L.) Trin. var. *mexicana*	Muhly Grass	2,9	KL*
	Oryzopsis asperifolia Michx.	Rough-leaved Mountain-rice	3,5	SV
	Panicum lanuginosum Ell. var. *implicatum* (Scribn.) Fern. (*P. implicatum* Scribn.)	Panic Grass	9,11	KL*,DC
	Phalaris arundinacea L.	Reed Canary Grass	9	KL*
+	*Phleum pratense* L.	Timothy	11,12	KL*,DC
	Poa alsodes L.	Woodland Poa	2	KL
+	*Poa annua* L.	Annual Blue Grass		KL*,DC
(+)	*Poa compressa* L.	Canada Blue Grass	1,4,11	KL*,DC
+	*Poa pratensis* L.	Kentucky Blue Grass	11	KL*,DC
	Schizachne purpurascens (Torr.) Sw.	False Melic Grass	1	SV*
	Sphenopholis intermedia (Rydb.) Rydb.	Slender Wedge Grass	5	KL*

Species	Common Name	Community Number	Source
CYPERACEAE	SEDGE FAMILY		
Carex arctata Boott	Sedge	1	SV*
Carex aurea Nutt.	Sedge	9,10,12	KL*
Carex bebbii (Bailey) Fern.	Sedge	9	KL*
Carex communis Bailey	Sedge		DC
Carex convoluta Mack. (incl. in *C. rosea* Schk. ex Willd.)	Sedge	2	KL*
Carex cf. *cristatella* Britt.	Sedge	9	KL*
Carex deweyana Schw.	Sedge	1,2,5	KL*
Carex diandra Schrank	Sedge	9	KL*
Carex digitalis Willd.	Sedge	1	SV*
Carex disperma Dew.	Sedge	6,8	DC
Carex eburnea Boott	Sedge	1,3,4,5	KL*
Carex flava L.	Sedge	2,6,9	KL*
r *Carex garberi* Fern.	Sedge		DC
Carex gracillima Schw.	Sedge	1,2	KL*
Carex hystericina Muhl. *ex* Willd.	Sedge	6,9	KL*
Carex interior Bailey	Sedge		DC
Carex intumescens Rudge	Sedge		DC
Carex lacustris Willd.	Sedge		DC
Carex leptonervia Fern.	Sedge	1	KL*
Carex lupulina Muhl. *ex* Willd.	Sedge		DC
Carex peckii Howe	Sedge	1,3	KL*,SV*

Species	Common Name	Community Number	Source
Carex pedunculata Muhl. *ex* Willd.	Sedge	1,2	KL*
Carex pensylvanica Lam.	Sedge	1	KL*
Carex platyphylla Carey	Sedge	1,5	KL*
Carex pseudocyperus L.	Sedge	9	KL*
Carex retrorsa Schw.	Sedge	6,9	KL*,DC
Carex scabrata Schw.	Sedge	1,6,9	KL*
Carex schweinitzii Schw.	Sedge	6,9	KL*
Carex stipata Muhl. *ex* Willd.	Sedge	6,9	KL*
Carex vesicaria L.	Sedge	9	KL*
Eleocharis acicularis (L.) R.&S.	Spike-rush	9	KL*
Eleocharis smallii Britt. (*E. palustris auct. amer., non* L.)	Spike-rush	6,9	KL*,DC
Scirpus acutus Bigel.	Hard-stemmed Bulrush	6,9	KL*,DC
Scirpus atrovirens Willd.	Black Bulrush	6,9	KL*,DC
Scirpus cyperinus (L.) Kanth. var. *cyperinus*	Wool-grass	6,8,9	KL*
Scirpus validus Vahl	Softstem Bulrush	6,9	KL*
ARACEAE	ARUM FAMILY		
Arisaema triphyllum (L.) Schott	Jack-in-the-pulpit	1,4,5	KL*,DC
LEMNACEAE	DUCKWEED FAMILY		
Lemna minor L.	Common Duckweed	6,9	KL*,DC
Lemna trisulca L.	Star Duckweed	10	KL

Species	Common Name	Community Number	Source
JUNCACEAE	RUSH FAMILY		
Juncus alpinoarticulatus Chaix *in* Vill. (*Juncus alpinus* Villars)	Rush		DC
Juncus dudleyi Wieg.	Rush	9	KL*
Juncus effusus L. ssp. *solutus* (Fern. & Wieg.) Hamet-Ahti (*J. effusus* L. var. *solutus* Fern. & Wieg.) (*J. griscomii* Fern.)	Rush	9	KL*,DC
Juncus nodosus L.	Rush	9	KL*
Juncus tenuis Willd.	Path Rush	9,11	KL*,DC
LILIACEAE	LILY FAMILY		
Allium tricoccum Ait.	Wild Leek, Ramps	1	KL
+ *Asparagus officinalis* L.	Garden Asparagus	11	KL*
Clintonia borealis (Ait.) Raf.	Bluebead-lily	2,6	KL*,DC
Erythronium americanum Ker	Yellow Trout-lily	1,2,5,12	KL,DC
+ *Hemerocallis fulva* (L.) L.	Orange Day-lily	11	KL*
Maianthemum canadense Desf.	Wild Lily-of-the-valley	1,2,3,5,6,8	KL*
Medeola virginiana L.	Indian Cucumber-root	1,2	KL*,SV*
Polygonatum pubescens (Willd.) Pursh	Solomon's-seal	1,2,3,5	KL*,DC
Smilacina racemosa (L.) Desf.	False Solomon's-seal	1,3,5	KL,DC
Smilacina trifolia (L.) Desf.	Three-leaved False Solomon's-seal	6,8	KL*,DC
Streptopus roseus Michx.	Rose Twisted Stalk	1,2	KL*,DC
Trillium erectum L.	Purple Trillium, Stinking Benjamin	1,2,5	KL*,DC

	Species	Common Name	Community Number	Source
	Trillium grandiflorum (Michx.) Salisb.	Common Trillium	1,5	KL*,DC
	Uvularia grandiflora Sm.	Bellwort	1	KL*,DC
	IRIDACEAE	IRIS FAMILY		
	Iris versicolor L.	Wild Blue Flag	9	KL*
	Sisyrinchium angustifolium Miller	Narrow-leaved Blue-eyed Grass	11	DC
	Sisyrinchium montanum Greene	Little Blue-eyed Grass	11	DC
	ORCHIDACEAE	ORCHID FAMILY		
O	*Corallorhiza maculata* (Raf.) Raf.	Spotted Coral-root	1A,D	KL,DC,SV*
O	*Corallorhiza trifida* Chat.	Early or Pale Coral-root	6C	DC
	Cypripedium calceolus L.	Yellow Lady Slipper		DC
+	*Epipactis helleborine* (L.) Crantz	Helleborine	1,3,5,6	KL*,DC
	Liparis loeselii (L.) Rich.	Loesel's Twayblade	10K	KL
	Platanthera hyperborea (L.) Lindl. (*Habenaria hyperborea* (L.)	Northern Green Orchid	6	KL*,DC
	Spiranthes cernua (L.) Rich.	Nodding Ladies'-tresses	10K	KL*
	SALICACEAE	WILLOW FAMILY		
	Populus balsamifera L.	Balsam Poplar	2,6,11	KL*,DC
	Populus grandidentata Michx.	Large-toothed Aspen	1,2,3,5,11	KL*,DC
	Populus tremuloides Michx.	Trembling Aspen	2,11,12	KL*,DC
	Salix alba L. + var. *vitellina* (L.) Stokes X *S. babylonica* L.	Weeping Willow	9	KL*
	Salix amygdaloides Anderss.	Peach-leaved Willow	6,9	KL*

Species	Common Name	Community Number	Source
Salix bebbiana Sarg.	Beaked Willow, Bebb's Willow	6,9	KL*
Salix discolor Muhl.	Pussy Willow	6,9	KL*,DC
Salix eriocephala Michx. (*S. rigida* Muhl.)	Heart-leaved Willow	6,9	KL*
Salix exigua Nutt. (*S. interior* Rowlee)	Sandbar Willow	9	KL*
Salix humilis Marsh.	Upland Willow	9,11	KL*
Salix lucida Muhl.	Shining Willow	6,9	KL*
JUGLANDACEAE	WALNUT FAMILY		
Juglans cinerea L.	Butternut	1,2,5,11	KL*,DC
BETULACEAE	BIRCH FAMILY		
Alnus rugosa (Du Roi) Spreng.	Speckled Alder	6	KL*,DC
Betula alleghaniensis Britt. (*B. lutea auct.,non* Michx.)	Yellow Birch	2,3,4,5,6,7,8	KL*,DC
Betula papyrifera Marsh.	White Birch	1,2,3,4,5,6,11,12	KL*,DC
Ostrya virginiana (Mill.) K. Koch	Ironwood	1,2,3,5,11	KL,DC
FAGACEAE	BEECH FAMILY		
Fagus grandifolia Ehrh.	American Beech	1,2,3,5,11	KL*,DC
ULMACEAE	ELM FAMILY		
Ulmus americana L.	White Elm	2,6,11	KL*,DC
Ulmus rubra Muhl.	Red or Slippery Elm	6	KL*,DC
URTICACEAE	NETTLE FAMILY		
Laportea canadensis (L.) Wedd.	Wood Nettle	1,2,5	KL*,DC
Pilea pumila (L.) Gray	Clearweed	5	KL*,DC

	Species	Common Name	Community Number	Source
	Urtica dioica L. subsp. *gracilis* (Ait.) Seland. (*U. procera* Muhl.)	American Stinging Nettle	9,11	KL*,DC
	ARISTOLOCHIACEAE	BIRTHWORT FAMILY		
	Asarum canadense L.	Wild Ginger	1,5	KL*
	POLYGONACEAE	BUCKWHEAT FAMILY		
+	*Fagopyrum esculentum* Moenchh	Buckwheat	11	KL*
	Polygonum cilinode Michx.	Fringed Buckwheat		DC
	Polygonum hydropiperoides Michx.	Mild Waterpepper	8,9	KL*
	Polygonum punctatum Ell.	Smartweed	2,6,9,11	KL*
+	*Rumex acetosella* L.	Sheep Sorrel	11	KL,DC
+	*Rumex crispus* L.	Curly Dock	11	KL*,DC
+	*Rumex obtusifolius* L.	Bitter Dock	2,6,9,11	KL*
	Rumex orbiculatus Gray	Great Water Dock		DC
	CHENOPODIACEAE	SPINACH FAMILY		
+	*Chenopodium album* L.	Lamb's-quarters, Pigweed	11	KL*,DC
	Chenopodium capitatum (L.) Aschers.	Strawberry-blite	11	KL*
	Chenopodium hybridum L. var. *gigantospermum* (Aellen) Rouleau	Maple-leaved Goosefoot	6	KL*
	AMARANTHACEAE	AMARANTH FAMILY		
+	*Amaranthus retroflexus* L.	Redroot Pigweed		DC
	PORTULACACEAE	PURSLANE FAMILY		
	Claytonia caroliniana Michx.	Broad-leaved Spring Beauty	1	KL

	Species	Common Name	Community Number	Source
	CARYOPHYLLACEAE	PINK FAMILY		
	Cerastium arvense L.	Field Chickweed		DC
+	*Cerastium fontanum* Baumg. (ssp. *triviale* (Link) Jatas; *C. vulgatum* L.)	Mouse-eared Chickweed	9,11	KL*
+	*Dianthus armeria* L.	Deptford Pink	9,11	KL*
+	*Saponaria officinalis* L.	Bouncing-bet, Soapwort	11	KL*
+	*Silene vulgaris* (Moench) Garcke (*S. cucubalus* Wibel)	Bladder Campion	11	KL*,DC
+	*Stellaria media* (L.) Vill.	Common Chickweed		DC
	NYMPHAEACEAE	WATER-LILY FAMILY		
	Nuphar variegata Durand	Bullhead Lily	10	KL*,DC
	Nymphaea odorata Ait.	Fragrant Water-lily	10	KL*,DC
	RANUNCULACEAE	CROWFOOT FAMILY		
	Actaea pachypoda Ell. (*A. alba sensu* Bibel.)	White Baneberry, Doll's-eyes	1,2,5	KL*
	Actaea rubra (Ait.) Willd.	Red Baneberry	1,2,5	KL*
	Anemone canadensis L.	Canada Anemone		DC
	Anemone cylindrica Gray	Long-fruited Anemone	11	KL*
	Anemone virginiana L. (incl. *A. riparia* Fern.)	Thimbleweed	1,2	KL*
	Aquilegia canadensis L.	Wild Columbine	4,11	KL*,DC
	Caltha palustris L.	Marsh-marigold	6E	KL,DC
	Clematis virginiana L.	Virgin's-bower	2,6,11	KL*,DC
	Coptis trifolia (L.) Salisb. (*C. groenlandica* (Oeder) Fern.)	Gold-thread	2,6,8	KL*,DC
	Ranunculus abortivus L.	Small-flowered Buttercup	1,3,5	KL*

	Species	Common Name	Community Number	Source
+	*Ranunculus acris* L.	Tall Buttercup	11	KL*,DC
	Ranunculus pensylvanicus L. f.	Bristly Crowfoot	9	KL*,DC
	Ranunculus recurvatus Poir.	Hooked Buttercup	1	KL*,DC
	Ranunculus sceleratus L.	Cursed Crowfoot	9	KL*,DC
	Thalictrum dioicum L.	Early Meadow Rue	1	DC
	Thalictrum pubescens Pursh (*T. polygamum* Bart.)	Tall Meadow Rue		DC
	BERBERIDACEAE	BARBERRY FAMILY		
	Caulophyllum thalictroides (L.) Michx.	Blue Cohosh	1,5	KL,DC
	PAPAVERACEAE	POPPY FAMILY		
+	*Chelidonium majus* L.	Celandine	2	KL*
	FUMARIACEAE	FUMITORY FAMILY		
	Dicentra canadensis (Goldie) Walp.	Squirrel-corn	1,5	KL
L	*Dicentra cucullaria* (L.) Bernh.	Dutchman's-breeches	1A,4B	KL
	BRASSICACEAE	MUSTARD FAMILY		
R	*Arabis hirsuta* (L.) Scop. var. *pycnocarpa* (Hopkins) Rollins	Rock-cress	4A,B	KL*
+	*Capsella bursa-pastoris* (L.) Medic.	Shepherd's-purse	11	DC
	Dentaria diphylla Michx.	Toothwort	1,5	KL,DC
O	*Dentaria laciniata* Muhl.	Cutleaf Toothwort	1A	KL
+	*Erysimum cheiranthoides* L.	Wormseed Mustard	11	KL*,DC
+	*Lepidium campestre* (L.) R. Br.	Field Pepper-grass	11	KL
+	*Lepidium ruderale* L.	Pepper-grass	11	KL*

	Species	Common Name	Community Number	Source
+	*Nasturtium microphyllum* (Boenn.) Reichenb. (incl. *N. officinale* R. Br.)	Water Cress	9	KL*,DC
	Rorippa palustris (L.) Besser ssp. *fernaldiana* (Butt. & Abbe) Jonsell (*R. islandica* (Oeder) Borbas var. *fernaldiana* Butt. & Abbe)	Marsh Yellow Cress	9	KL*
+	*Sisymbrium officinale* (L.) Scop.	Hedge Mustard	11	KL*
+	*Thlaspi arvense* L.	Penny Grass		DC
	SAXIFRAGACEAE	SAXIFRAGE FAMILY		
	Chrysosplenium americanum Hooker	Golden Saxifrage	6	DC
	Mitella diphylla L.	Bishop's Cap	4,5	KL*,DC
	Mitella nuda L.	Naked Mitrewort	2,4,5,6	KL*,DC
	Tiarella cordifolia L.	Foam Flower	2,5,6	KL*,DC
	GROSSULARIACEAE	GOOSEBERRY FAMILY		
	Ribes americanum Mill.	Wild Black Currant		DC
	Ribes cynosbati L.	Prickly Gooseberry	2,5	KL*,DC
	Ribes glandulosum Grauer	Skunk Currant		DC
	Ribes hirtellum Michx. (*R. oxyacanthoides* L.) var. *hirtellum* (Michx.) Scoggan)	Canada Gooseberry	1,4,11	KL*
	Ribes lacustre (Pers.) Poir.	Swamp Black Currant	3,5	KL*,DC
	Ribes triste Pall.	Swamp Red Currant		DC
	ROSACEAE	ROSE FAMILY		
	Agrimonia gryposepala Wallr.	Agrimony	1,2,5,6,9,11	KL*,DC

	Species	Common Name	Community Number	Source
L	*Amelanchier arborea* (Michx. f.) Fern.	Juneberry, Serviceberry	11B	KL*
L	*Amelanchier spicata* (Lam.) K. Koch var. *spicata*	Juneberry, Serviceberry	1D	SV*
	Crataegus chrysocarpa Ashe	Hawthorn	11,12	KL*
+	*Crataegus monogyna* Jacq.	English Hawthorn	11,12	KL*
	Crataegus punctata Jacq.	Dotted Hawthorn	11,12	KL*
	Crataegus succulenta Link	Hawthorn	11,12	KL*
	Fragaria vesca L.	Woodland Strawberry	2,11	KL*,DC
	Fragaria virginiana Dcne.	Common Strawberry	11,12	KL*,DC
	Geum aleppicum Jacq. var. *strictum* (Ait.) Fern.	Yellow Avens	11	KL*
	Geum canadense Jacq.	White Avens		KL*,DC
+	*Malus domestica* Borkh. (*Pyrus malus* L.)	Apple	11	KL*,DC
+	*Potentilla argentea* L.	Silvery Cinquefoil	11	KL*,DC
+	*Potentilla norvegica* L.	Rough Cinquefoil		DC
+	*Potentilla recta* L.	Rough-fruited Cinquefoil	11,12	KL*,DC
	Prunus nigra Ait.	Canada Plum		DC
	Prunus pensylvanica L. f.	Pin Cherry	12	KL*,DC
	Prunus serotina Ehrh.	Wild Black Cherry	1,2,11,12	KL*,DC
	Prunus virginiana L.	Chokecherry	11,12	KL*,DC
+	*Pyrus communis* L.	Pear	11,12	KL*
	Rosa acicularis Lindl.	Wild Rose		DC
+	*Rosa eglanteria* L. (*R. rubiginosa* L.)	Sweet Brier Rose	11	KL*

	Species	Common Name	Community Number	Source
	Rubus allegheniensis Porter	Common Blackberry	11,12	KL*,DC
	Rubus occidentalis L.	Black Raspberry	11	KL*
	Rubus pubescens Raf.	Dwarf Raspberry	5,6	KL*,DC
	Rubus strigosus Michx. (*R. idaeus* L. var. *strigosus* (Michx.) Maxim.)	Wild Red Raspberry	1,2,6,11,12	KL,DC
R	*Sorbus americana* Marsh. (*Pyrus americana* (Marsh.) DC.)	Mountain-ash	5B	DC
+	*Sorbus aucuparia* L. (*Pyrus aucuparia* (L.) Gaertn.)	European Mountain-ash	11	KL*
	Spiraea alba DuRoi (incl. *S. latifolia* (Ait.) Borkh.)	Meadowsweet	11	KL*
	FABACEAE	PEA FAMILY		
+	*Lotus corniculatus* L.	Bird-foot Trefoil	11	DC
+	*Medicago lupulina* L.	Black Medic	11	DC
+	*Medicago sativa* L. ssp. *sativa*	Alfalfa	11	KL*,DC
+	*Melilotus alba* Medic.	White Sweet-clover	11	KL*,DC
+	*Melilotus officinalis* (L.) Pall.	Yellow Sweet-clover	11	KL*,DC
+	*Trifolium aureum* Poll. (*T. agrarium* L.)	Hop Clover		DC
+	*Trifolium campestre* Schreb. (*T. procumbens* L.)	Low Hop Clover	11	KL*
+	*Trifolium dubium* Sibth.	Small Hop Clover	11	KL*
+	*Trifolium hybridum* L.	Alsike Clover		DC
+	*Trifolium pratense* L.	Red Clover	11	KL*,DC
+	*Trifolium repens* L.	White Clover	11	KL*,DC
	Vicia americana Willd.	Vetch	2	KL*

	Species	Common Name	Community Number	Source
+	*Vicia cracca* L.	Bird Vetch	11	KL*,DC
+	*Vicia sativa* L. ssp. *nigra* (L.) Ehrh. (*V. angustifolia* Reich.; *V. sativa* L.	Common Vetch	9	KL*,DC
	GERANIACEAE	GERANIUM FAMILY		
+	*Geranium robertianum* L.	Herb Robert	1,2,4,5	KL*,DC
	OXALIDACEAE	WOOD-SORREL FAMILY		
	Oxalis fontana Bunge (*O. stricta auct. amer.*, *non* L., *O. europaea* Jordan)	Wood-sorrel	1,2,6	KL*,DC
	Oxalis montana Raf. (*O.* acetosella L.)	Wood-sorrel	2,6	KL,DC
	EUPHORBIACEAE	SPURGE FAMILY		
+	*Euphorbia cyparissias* L.	Cypress Spurge	11,12	KL,DC
	ANACARDIACEAE	CASHEW FAMILY		
	Rhus typhina L.	Staghorn Sumac	11,12	KL*,DC
	AQUIFOLIACEAE	HOLLY FAMILY		
	Ilex verticillata (L.) Gray	Winterberry	8A	KL*,DC
	CELASTRACEAE	STAFF-TREE FAMILY		
	Celastrus scandens L.	Climbing Bittersweet	3,12	KL*
	ACERACEAE	MAPLE FAMILY		
	Acer negundo L.	Manitoba Maple	11	KL
+	*Acer platanoides* L.	Norway Maple	11	KL*
	Acer rubrum L.	Red Maple	1,2,3,6,8	KL*,DC
	Acer saccharum Marsh.	Sugar Maple	1,2,3,4,5,11,12	KL*,DC
	Acer spicatum Lam.	Mountain Maple	1,2,3,4,5,6	KL*,DC

	Species	Common Name	Community Number	Source
	BALSAMINACEAE	TOUCH-ME-NOT FAMILY		
	Impatiens capensis Meerb. (*I. biflora* Willd.)	Spotted Jewelweed, Touch-me-not	5,6,9	KL*,DC
	Impatiens pallida Nutt.	Jewelweed	1,4,5	KL*,DC
	RHAMNACEAE	BUCKTHORN FAMILY		
	Rhamnus alnifolia L'Her.	Alder-leaved Buckthorn		DC
+	*Rhamnus cathartica* L.	Common Buckthorn		DC
	VITACEAE	GRAPE FAMILY		
	Parthenocissus inserta (A. Kerner) K. Fritsch (*P. vitacea* (Knerr) Hitchc.)	Virginia Creeper	5	KL*
	Vitis riparia Michx.	Riverbank Grape	11,12	KL*,DC
	TILIACEAE	LINDEN FAMILY		
	Tilia americana L.	Basswood	1,2,3,5,11	KL*,DC
	MALVACEAE	MALLOW FAMILY		
+	*Malva moschata* L.	Musk Mallow	11	KL*,DC
+	*Malva neglecta* Wallr.	Common Mallow		DC
	HYPERICACEAE	ST. JOHN'S-WORT FAMILY		
L	*Hypericum ascyron* L. (*H. pyramidatum* Ait.)	Great St. John's-wort	6D,9B	KL*
+	*Hypericum perforatum* L.	Common St. John's-wort	11	KL*,DC
	Triadenum fraseri (Spach) Gl. (*Hypericum virginicum* L. var. *fraseri* (Spach) Fern.)	Marsh St. John's-wort		DC
	VIOLACEAE	VIOLET FAMILY		
	Viola canadensis L.	Canada Violet	1,2	KL*,DC
	Viola conspersa Reich.	Dog Violet	1	KL*,DC

	Species	Common Name	Community Number	Source
	Viola nephrophylla Greene	Violet		DC
	Viola pallens (Banks) Brain. (*V. macloskeyi* Lloyd ssp. *pallens* (Banks) M.S. Baker)	Smooth White Violet	2,6	KL*
	Viola pubescens Ait. (incl. var. *pubescens* and var. *scabriuscula* T. & G.; *V. pensylvanica sensu auct., non* Michx. var. *leiocarpa* (Fern. & Wieg.) Fern.)	Downy Yellow Violet	1,2	KL*,SV*,DC
	Viola renifolia Gray (var. *brainerdii* (Greene) Fern.)	Kidney-leaved Violet	4,5	KL*,DC
	Viola selkirkii Pursh	Great-spurred Violet	2,3	KL*,SV*
	Viola septentrionalis Greene	Violet	11,12	KL*
	THYMELAEACEAE	MEZEREUM FAMILY		
O	*Dirca palustris* L.	Leatherwood	1	KL*
	ONAGRACEAE	EVENING-PRIMROSE FAMILY		
	Circaea alpina L.	Small Enchanter's Nightshade	4,5	KL*,DC
	Circaea lutetiana L. var. *canadensis* L. (*C. quadrisulcata* (Maxim.) Franch. & Sav.)	Enchanter's Nightshade	1,5,6,11	KL*,DC
	Epilobium angustifolium L.	Fireweed	11	KL*
	Epilobium ciliatum Raf. (*E. glandulosum* Lehm. var. *adenocaulon* (Haussk.) Fern.; includes typical *E. glandulosum* Lehm.)	Sticky Willowherb	6,9	KL*
	Oenothera biennis L.	Hairy Yellow Evening-primrose	11	KL*
	Oenothera parviflora L.	Small-flowered Evening-primrose	2,11	KL*

	Species	Common Name	Community Number	Source
	ARALIACEAE	GINSENG FAMILY		
	Aralia nudicaulis L.	Wild Sarsaparilla	1,2,3,5	KL*,DC
	Aralia racemosa L.	Spikenard	4,5,6,8	KL*,DC
NP	*Panax quinquefolius* L.	Ginseng	5D	KL*
	APIACEAE	CARROT FAMILY		
+	*Aegopodium podagraria* L.	Goutweed	2	KL*
	Cicuta bulbifera L.	Bulbous Water-hemlock	9	KL*
	Cicuta maculata L.	Spotted Water-hemlock		DC
+	*Daucus carota* L.	Wild Carrot, Queen Anne's Lace	11,12	KL*,DC
	Osmorhiza claytonii (Michx.) Clarke	Sweet Cicely	1	KL*,SV*,DC
	Osmorhiza longistylis (Torr.) DC.	Anise-root		DC
	Sium suave Walt.	Water-parsnip	8	KL*,DC
	CORNACEAE	DOGWOOD FAMILY		
	Cornus alternifolia L.f.	Alternate-leaved Dogwood	1,2,5	KL*,DC
	Cornus canadensis L.	Bunchberry	1,6,8	KL*
	Cornus rugosa Lam.	Round-leaved Dogwood	4,5,11	KL*
	Cornus stolonifera Michx.	Red-osier Dogwood	6,9,11,12	KL*,DC
	PYROLACEAE	WINTERGREEN FAMILY		
	Monotropa uniflora L.	Indian-pipe	1,2,6	KL*,SV*
	Orthilia secunda (L.) House (*Pyrola secunda* L.)	One-sided Pyrola or Wintergreen		DC
	Pyrola americana Sweet (*P. rotundifolia* L.)	Round-leaf Shinleaf		DC
	Pyrola chlorantha Sw. (*P. virens* Schweig.)	Shinleaf	1,3	SV*

	Species	Common Name	Community Number	Source
	Pyrola elliptica Nutt.	Shinleaf		DC
	ERICACEAE	HEATH FAMILY		
O	*Chamaedaphne calyculata* (L.) Moench	Leather-leaf	8	KL*,DC
O	*Gaultheria hispidula* (L.) Bigel.	Creeping Snowberry	8	KL*
O	*Gaultheria procumbens* L.	Checkerberry, Wintergreen	8	KL*
O	*Ledum groenlandicum* Oeder	Labrador-tea	8	KL*
	PRIMULACEAE	PRIMROSE FAMILY		
	Lysimachia ciliata L. (*Steironema ciliata* (L.) Raf.)	Fringed Loosestrife	6,9	KL*
+	*Lysimachia nummularia* L.	Moneywort	1,2,6	KL*
	Lysimachia terrestris (L.) BSP.	Swamp Candles	8	KL*
	Trientalis borealis Raf.	Star-flower	2,6	KL*,DC
	OLEACEAE	OLIVE FAMILY		
	Fraxinus americana L.	White Ash	1,2,3,4,5,11,12	KL*,DC
	Fraxinus nigra Marsh.	Black Ash	6	KL*,DC
	Fraxinus pennsylvanica Marsh. var. *pennsylvanica*	Red Ash	6	KL*,DC
+	*Syringa vulgaris* L.	Common Lilac	11	KL*,DC
	GENTIANACEAE	GENTIAN FAMILY		
O	*Menyanthes trifoliata* L.	Bog Buckbean	8	DC
	APOCYNACEAE	DOGBANE FAMILY		
	Apocynum androsaemifolium L.	Spreading Dogbane	11	KL*,DC
+	*Vinca minor* L.	Periwinkle	1	KL*

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	ASCLEPIADACEAE	MILKWEED FAMILY		
	Asclepias incarnata L.	Swamp Milkweed	6,9	KL*,DC
	Asclepias syriaca L.	Common Milkweed	11	KL*,DC
	CONVOLVULACEAE	MORNING GLORY FAMILY		
	Calystegia sepia (L.) R.Br. (*Convolvulus sepium* L.)	Hedge Bindweed, Wild Morning Glory	9	KL*
	HYDROPHYLLACEAE	WATERLEAF FAMILY		
	Hydrophyllum canadense L.	Canada Waterleaf	5C	KL*,DC
	Hydrophyllum virginianum L.	Virginia Waterleaf	5	KL*,DC
	BORAGINACEAE	BORAGE FAMILY		
+	*Cynoglossum officinale* L.	Hound's-tongue	11	KL*,DC
+	*Echium vulgare* L.	Blueweed, Viper's-bugloss	11	KL*,DC
	Hackelia virginiana (L.) Johnston	Stickseed, Beggar's-lice	2,4	KL*
+	*Lithospermum arvense* L.	Corn Gromwell		DC
+	*Lithospermum officinale* L.	Pearl or Common Gromwell	11	KL*,DC
	Myosotis laxa Lehm.	Smaller Forget-me-not	9	KL*
	VERBENACEAE	VERVAIN FAMILY		
L	*Verbena stricta* Vent.	Hoary Vervain	11B	KL*
	LAMIACEAE	MINT FAMILY		
+	*Galeopsis tetrahit* L.	Hemp-nettle	1,11	KL*,DC
+	*Glechoma hederacea* L.	Ground-ivy	11	KL*,DC
+	*Leonurus cardiaca* L.	Motherwort	3,4,11	KL*
	Lycopus americanus Muhl.	American Water-horehound	6,9	KL*
+	*Lycopus europaeus* L.	European Water-horehound	6,9	KL*

	Species	Common Name	Community Number	Source
	Lycopus uniflorus Michx.	Water-horehound	6,8,9	KL,DC
	Mentha arvensis L. var. *glabrata* (Benth.) Fern.	Field or Common Mint	6,9	KL*,DC
	Monarda fistulosa L.	Wild Bergamot		DC
+	*Nepeta cataria* L.	Catnip	4,11	KL*,DC
	Prunella vulgaris L.	Heal-all	6	KL*,DC
	Satureja vulgaris (L.) Fritsch var. *neogaea* Fern.	Dogmint	4,11,12	KL*
	Scutellaria galericulata L. (*S. epilobiifolia* A. Ham.)	Common Skullcap	6,9	KL*
	Scutellaria lateriflora L.	Mad-dog Skullcap	6,9	KL*
	SOLANACEAE	NIGHTSHADE FAMILY		
	Physalis heterophylla Nees	Clammy Ground-cherry	11	KL*,DC
	Solanum americanum Mill. (*S. nigrum* L. var. *americanum* (Mill.) Schulz)	American Nightshade	1,6,11	KL*
+	*Solanum dulcamara* L.	Bittersweet	5,6,9,11	KL*,DC
	SCROPHULARIACEAE	FIGWORT FAMILY		
	Chelone glabra L.	Turtlehead	6	DC
+	*Linaria vulgaris* Hill	Toadflax, Butter-and-eggs	4,11	KL*
	Mimulus ringens L.	Square-stemmed Monkeyflower	6,9	KL*,DC
	Scrophularia lanceolata Pursh	Lance-leaved Figwort	11	DC
+	*Verbascum thapsus* L.	Common Mullein	11	KL*,DC
	Veronica americana (Raf.) Schwein.	American Brooklime	9	KL*,DC
+	*Veronica anagallis-aquatica* L.	Water-speedwell	9	KL*,DC
+	*Veronica officinalis* L.	Common Speedwell	11,12	KL*,DC

	Species	Common Name	Community Number	Source
	Veronica peregrina L.	Purslane Speedwell		DC
+	*Veronica serpyllifolia* L.	Thyme-leaved Speedwell		DC
	OROBANCHACEAE	BROOM-RAPE FAMILY		
	Epifagus virginiana (L.) Bart.	Beech-drops	1,2,3	KL*,DC
	PHRYMACEAE	LOPSEED FAMILY		
	Phryma leptostachya L.	Lopseed	1	KL*
	PLANTAGINACEAE	PLANTAIN FAMILY		
+	*Plantago lanceolata* L.	English Plantain	11	KL*,DC
+	*Plantago major* L.	Broad-leaved Plantain	11	KL*,DC
	Plantago rugelii Dcne.	Rugel's Plantain	11	KL*
	RUBIACEAE	MADDER FAMILY		
	Galium aparine L.	Cleavers		DC
+	*Galium mollugo* L.	Bedstraw	11	KL*
	Galium obtusum Bigel.	Bedstraw		DC
	Galium trifidum L. var. *trifidum*	Bedstraw	9	KL*
	Galium triflorum Michx.	Sweet-scented Bedstraw	1,2,4,5,6	KL*,DC
	Mitchella repens L.	Partridge-berry	1,2	KL*,DC
	CAPRIFOLIACEAE	HONEYSUCKLE FAMILY		
	Diervilla lonicera Mill.	Bush-honeysuckle	1,3,4,5	KL*,DC
	Linnaea borealis L.	Twinflower	6	KL*
	Lonicera canadensis Marsh.	Fly-honeysuckle	2,5	KL*,DC
	Lonicera dioica L.	Wild Honeysuckle		DC
	Lonicera hirsuta Eat.	Hairy Honeysuckle		DC

	Species	Common Name	Community Number	Source
	Sambucus canadensis L.	Common Elder	9	KL*,DC
	Sambucus pubens Michx.	Red-berried Elder	1,4,5,11	KL*,DC
	Viburnum acerifolium L.	Maple-leaved Viburnum	1,3	KL*
L	*Viburnum alnifolium* Marsh.	Hobblebush	1A	KL*
L	*Viburnum cassinoides* L.	Witherod, Wild-raisin	8	DC
+	*Viburnum opulus* L.	Guelder-rose	11	KL*
	Viburnum trilobum Marsh. (*V. opulus* L. var. *americanum* Ait.)	Highbush-cranberry		DC
	DIPSACACEAE	TEASEL FAMILY		
+	*Dipsacus fullonum* L. (*D. sylvestris auct. amer.*, *non* Huds.)	Teasel	9,11	KL*,DC
	CAMPANULACEAE	BLUEBELL FAMILY		
	Campanula aparinoides Pursh	Marsh-bellflower		DC
	LOBELIACEAE	LOBELIA FAMILY		
	Lobelia cardinalis L.	Cardinal Flower	9	KL
	Lobelia inflata L.	Indian Tobacco	1,11	KL*
	ASTERACEAE	ASTER FAMILY		
+	*Achillea millefolium* L.	Yarrow	4,11	KL*,DC
	Ambrosia artemisiifolia L.	Common Ragweed	11	KL*,DC
	Anaphalis margaritacea (L.) Clarke	Pearly Everlasting	11	KL*,DC
	Antennaria neglecta Greene (incl. *A. neodioica* Greene and *A. canadensis* Greene)	Pussytoes	1,4,11,12	KL*,SV,DC
+	*Arctium minus* (Hill) Bernh.	Common Burdock	1,2,6,9,11	KL*,DC

	Species	Common Name	Community Number	Source
	Aster ericoides L. (*Virgulus e.* (L.) Rev. & Keen.)	Heath Aster	11,12	KL*
	Aster lanceolatus Willd. (*A. simplex* Willd.)	Tall White Aster	11	KL*
	Aster macrophyllus L.	Large-leaved Aster	2	KL*
	Aster novae-angliae L. (*Virgulus n.* (L.) Rev. & Keen.)	New England Aster	9,11,12	KL*
	Aster puniceus L.	Red-stemmed Aster	6,9	KL*
	Bidens cernua L.	Nodding Beggarticks	9	KL*,DC
+	*Chrysanthemum leucanthemum* L. (*Leucanthemum vulgare* Lam.)	Ox-eye Daisy	11	KL*,DC
+	*Cichorium intybus* L.	Chicory	11	KL*
+	*Cirsium arvense* (L.) Scop.	Canada Thistle	6,9,11	KL*,DC
	Cirsium muticum Michx.	Swamp Thistle	9,11	KL*,DC
+	*Cirsium vulgare* (Savi) Tenore	Bull Thistle	9,11	KL*,DC
	Conyza canadensis (L.) Cronq. (*Erigeron canadensis* L.)	Horse-weed	6,11	KL*
	Erigeron annuus (L.) Pers. ssp. *annuus*	Annual Fleabane		DC
	Erigeron philadelphicus L.	Philadelphia Fleabane	11	KL*,DC
	Erigeron pulchellus Michx.	Robin's-plantain	6,9	KL*
	Eupatorium maculatum L.	Spotted Joe-Pye Weed	6,9	KL*,DC
	Eupatorium perfoliatum L.	Boneset	6,9	KL*,DC
	Eupatorium rugosum Houtt.	White Snakeroot	5,6,9	KL*,DC
+	*Hieracium aurantiacum* L.	Orange Hawkweed, Devil's Paintbrush	11,12	KL,DC
+	*Hieracium caespitosum* Dum. (*H. pratense* Tausch)	Yellow Hawkweed	3,11,12	SV*,DC

	Species	Common Name	Community Number	Source
+	*Hieracium piloselloides* Vill. (*H. florentinum* All.)	King Devil Hawkweed	1	KL*,DC
	Lactuca biennis (Moench) Fern.	Tall Blue Lettuce	2	KL*
	Lactuca canadensis L.	Canada Lettuce	2,9,11	KL*
+	*Lapsana communis* L.	Nipplewort	2	KL*
+	*Matricaria matricarioides* (Less.) Porter	Pineapple Weed	11	DC
	Prenanthes altissima L.	Tall White Lettuce	2	KL*
	Rudbeckia hirta L.	Black-eyed Susan	11	KL*
	Senecio aureus L.	Golden Ragwort	9A	KL*
	Solidago canadensis L.	Canada Goldenrod	11,12	KL*
	Solidago graminifolia (L.) Salisb. (*Euthamia graminifolia* (L.) Nutt.)	Narrow-leaf Goldenrod	6,9,11	KL*
	Solidago nemoralis Ait.	Gray Goldenrod	4,11,12	KL*
	Solidago rugosa Mill.	Rough Goldenrod	3,6,11,12	KL*
+	*Sonchus arvensis* L. ssp. *arvensis*	Perennial Sow-thistle	2	KL*,DC
+	*Sonchus asper* (L.) Hill	Spiny Annual Sow-thistle		DC
+	*Sonchus oleraceus* L.	Annual Sow-thistle		DC
+	*Tanacetum vulgare* L.	Tansy	11	KL*
+	*Taraxacum officinale* Weber	Dandelion	1,4,11,12	KL*,DC
+	*Tragopogon dubius* Scop.	Goat's-beard	11	KL*,DC
+	*Tragopogon pratensis* L.	Meadow Goat's-beard	11	KL*,DC
+	*Tussilago farfara* L.	Sweet Coltsfoot	11	KL*

Species	Common Name	Community Number	Source
Species Requiring Confirmation			
Equisetum hyemale L. var. *affine* (Engelm.) A.A. Eat.	Scouring-rush		DB[1]
Equisetum pratense Ehrh.	Meadow Horsetail		DC
Osmunda claytoniana L.	Interrupted Fern		DB[1]
Thelypteris noveboracensis (L.) Nieuvw. (*Dryopteris noveboracensis* (L.) Gray)	New York Fern		DB[1]
Carex arcta Boott	Sedge		DC
Carex utriculata Boott (*C. rostrata* of authors)	Sedge		DC
Potentilla arguta Pursh.	Prairie Cinquefoil		DC
Parthenocissus quinquefolia L.	Virginia Creeper		DC
Proserpinaca palustris L.	Mermaid Weed		DC
Cornus foemina Mill. (*C. racemosa* Lam.)	Grey Dogwood		DC
Verbena simplex Lehm.	Vervain		DC

[1] Britton (1981) lists this species as being recorded from the park by another observer.

APPENDIX B: BRYOPHYTES OF MONO CLIFFS PROVINCIAL PARK

The following species of mosses and liverworts were collected from the park by J.L. Riley and K.M. Lindsay on 30 September 1989 and by K.M. Lindsay on 9 September 1989. These bryophytes were submitted to the Canadian Museum of Nature (CAN) where they were identified by R.R. Ireland, P.Y. Wong and L.M. Ley. With the exception of the sphagnum, they are species of cliff-face fissure systems (4C) and mixed talus slopes (5A).

Species	Community Number
Anomodon attenuatus (Hedw.) Hüb.	5A
Anomodon rostratus (Hedw.) Schimp.	4C
Anomodon viticulosus (Hedw.) Hook. & Tayl.	4C
Brachythecium rutabulum (Hedw.) B.S.G.	4C
Brachythecium salebrosum (Web. & Mohr.) B.S.G.	5A
Conocephalum conicum (L.) Lindb.	4C
Drepanocladus fluitans (Hedw.) Warnst.	8
Lepraria cf. finkii (B. de Le sol.) R.C. Harris ined.	4C
Mnium ambiguum H. Müll.	4C
Plagiomnium cuspidatum (Hedw.) Kop	4C,5A
Porella platyphylla (L.) Pfeiff.	4C
Rhodobryum ontariense (Kindb.) Kindb.	5A
Sphagnum palustre L.	8
Taxiphyllum deplanatum (Bruch & Schimp. ex Sull.) Fleisch.	4C

APPENDIX C: MAMMALS OF MONO CLIFFS PROVINCIAL PARK

The following lists the 22 species of mammals observed in the park by the author, Cuddy (1973a,b), Hood (pers. comm.) and Savage (pers. comm.). Nomenclature and order of species follows Whitaker (1980). Records include direct observations or presence indicated by scent, track or den. Future studies, especially of small mammals, could add a number of species to this list.

Star-nosed Mole	*Condylura cristata*[3]
Little Brown Bat	*Myotis lucifugus*[4]
Eastern Cottontail	*Sylvilagus floridanus*[3]
Snowshoe Hare	*Lepus americanus*[2,3]
European Hare	*Lepus capensis*[3]
Eastern Chipmunk	*Tamias striatus*[1,2]
Groundhog	*Marmota monax*[1,2]
Grey Squirrel	*Sciurus caroliniensis*[1]
Red Squirrel	*Tamiasciurus hudsonicus*[1,2]
Northern Flying Squirrel	*Glaucomys sabrinus*[3]
Beaver	*Castor canadensis*[1]
Deer Mouse	*Peromyscus maniculatus*[2]
Meadow Vole	*Microtus pensylvanicus*[2]
Muskrat	*Ondatra zibethicus*[3]
Southern Bog Lemming	*Synaptomys cooperi*[3]
Porcupine	*Erethizon dorsatum*[1,2]
Red Fox	*Vulpes vulpes*[1,2]
Raccoon	*Procyon lotor*[1,2]
Mink	*Mustela vison*[3]
Striped Skunk	*Mephitis mephitis*[2]
River Otter	*Lutra canadensis*[3]
White-tailed Deer	*Odocoileus virginianus*[1]

[1] Species observed by author.

[2] Species noted by Cuddy (1973a,b). Don Cuddy conducted fieldwork in the park during the period June 13-27, 1973.

[3] Species noted by Hood (pers. comm.). Bruce and Joyce Hood are biologists who lived on the third line within the park from 1979 to 1987.

[4] Live bat found in cave by Riley *et. al.* on 29 September 1990.

Bones collected during investigations by Riley, Savage, Mason, Warchol and Drdla, of a fissure approximately 25 m below the surface represented twelve mammal species and four other families (Savage 1990, p. 5,6 and pers. comm.). The taxa of mammal bones collected from the fissure are listed below. Because of the significance, sensitivity and dangers of this site, its location within the park is not included in this report.

Short-tailed Shrew	*Blarina brevicanda*
Shrew sp.	Soricidae sp.
Hairy-tailed Mole	*Parascalops breweri*
Little Brown Bat	*Myotis lucifugus*
Keen's Bat	*Myotis keenii*
Big Brown Bat	*Eptesicus fuscus*
Pika	*Ochotona* sp.
Snowshoe Hare	*Lepus americanus*
Hare/Cottontail sp.	Leporidae sp.
Eastern Chipmunk	*Tamius striatus*
Red Squirrel	*Tamiasciurus hudsonicus*
Mice/Voles	Cricetidae sp.
Porcupine	*Erethizan dorsatum*
Raccoon	*Procyon lotor*
Marten	*Martes americana*
White-tailed Deer	*Odocoileus virginianus*

Savage discussed the significance of the faunal findings in his report to the ministry (Savage 1990, p. 2). "Cave-dwelling species whose presence was not unexpected were the Short-tailed Shrew, Hairy-tailed Mole, the bats, the mice, the Porcupine and the Raccoon, all of which make use of caves frequently or on occasion as refuges or in search of food."

The Pika and Marten are of special significance as they no longer occur in this part of southern Ontario. At present Pika occur only in western North America, on talus slopes and steep boulder-covered hillsides (Whitaker 1980). "Hagmeier (1956) concluded that Martens occurred no further south than the southern limits of Algonquin Park, although previously occurring all through southern Ontario" (Savage 1990). Radiocarbon isotrace dating of the Pika bones found at Mono Cliffs has determined an age of 9000 years before present (Savage pers. comm.). The Marten bones, which were also collected at the surface of deposits in the cave, date from 510 years before present.

As well, silty deposits from two sites in the fissure have been collected and analysed for fossil pollen (McAndrews and Campbell 1990). They concluded that the bones found at one site were likely to be younger than 150 years old, while bones within the sediments of the other site likely date from the early Holocene. The lower three levels of the second site contained pollen of a small *Pinus* together with a few *Abies* and fit "... into zone 2a which spans 10,500-9,000 years BP. ... The earliest Holocene sediment is present, indicating that the crevice was formed not long after deglaciation, but the lack of erratic rocks suggest that it did not form before the last glaciation." (McAndrews and Campbell 1990, p. 2).

APPENDIX D: BIRDS OF MONO CLIFFS PROVINCIAL PARK

Eighty-two species of birds have been observed in the park. Of these, fifty-two species are considered to breed within the park. The categories of breeding evidence follow those outlined in the Atlas of Breeding Birds of Ontario (Cadman *et al.*, 1987, p. 18). The nomenclature and order of species also follows Cadman *et al.* (1987).

All observations are those of the author, unless otherwise noted. Four early morning surveys were devoted entirely to atlassing breeding birds; a total of 9 hours on 25 May and 2, 9, 17 June 1991. Other observations of breeding birds were made during field surveys of different habitats and geographic areas of the park. Records from Cuddy (1973) and several other observers are annotated on the table. The sources of these records, and other notes, are given at the end of the list of birds. The Ontario Breeding Bird Atlas Co-ordinator provided a summary of the data collected for Square 17NU77, and the names of the atlassers who worked in this square (Cadman pers. comm.).

Species Observed

x	A species observed in the park but which does not breed, or for which information on breeding evidence is lacking. A few species which are winter residents that do not breed in the region are included in this category.
X	Species observed in its breeding season (no evidence of breeding).

Possible Breeding

SH	Species observed in its breeding season in suitable nesting habitat.
SM	Single male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season. All the records on the list refer to singing males.

Probable Breeding

P	Pair observed in suitable nesting habitat in nesting season.
T	Permanent territory presumed through registration of territorial behaviour (song, etc.) on at least two days, a week or more apart, at the same place.
V	Visiting probable nest site.
N	Nest-building or excavation of a nest hole.

Confirmed Breeding

AE	Adults leaving or entering nest sites in circumstances indicating occupied nest (including high nests, nest holes, or nest boxes, the contents of which cannot be seen).
NE	Nest containing eggs.

COMMON NAME	OBSERVED	BREEDING EVIDENCE		
		POSSIBLE	PROBABLE	CONFIRMED
Great Blue Heron	x			
Canada Goose		SH		
Mallard	X[1]			
Blue-winged Teal		SH		
Turkey Vulture		SH		
Northern Harrier	x			
Sharp-shinned Hawk	X[1]			
Red-tailed Hawk		SH		
Ruffed Grouse			T	
Wild Turkey	x[2]			
Killdeer	X			
Spotted Sandpiper	X[1]			
Upland Sandpiper		SH		
American Woodcock		SH		
Ring-billed Gull	x[1]			
Herring Gull	x[1]			
Rock Dove	X[1]			
Mourning Dove			P	
Great Horned Owl				AE[3]
Common Nighthawk	X[1]			
Whip-poor-will	X[1]			
Ruby-throated Hummingbird	X[1]			
Belted Kingfisher			N[4]	
Yellow-bellied Sapsucker		SH		
Downy Woodpecker	X[1]			
Hairy Woodpecker		SH		
Northern Flicker			P	
Pileated Woodpecker		SH		
Eastern Wood-Peewee		SH		
Least Flycatcher		SH		

COMMON NAME	OBSERVED	BREEDING EVIDENCE		
		POSSIBLE	PROBABLE	CONFIRMED
Eastern Phoebe		SM		
Great Crested Flycatcher		SM		
Eastern Kingbird			P	
Horned Lark	X[1]			
Tree Swallow			V	
Northern Rough-Winged Swallow	X[1]			
Bank Swallow	X[1]			
Barn Swallow		SH		
Blue Jay		SH		
Common Crow		SH		
Black-capped Chickadee		SH		
White-breasted Nuthatch		SH		
Brown Creeper	X[1]			
House Wren	X[1]			
Winter Wren			T	
Eastern Bluebird				NE[5]
Veery		SM		
Wood Thrush			P	
American Robin			P	
Brown Thrasher		SH		
Cedar Waxwing		SH		
European Starling	X			
Warbling Vireo			T[7]	
Red-eyed Vireo			T	
Nashville Warbler			T	
Yellow Warbler		SM		
Chestnut-sided Warbler			P	
Black-throated Green Warbler	X[1]			
Black-and-white Warbler			T[7]	
American Redstart			P	

COMMON NAME	OBSERVED	BREEDING EVIDENCE		
		POSSIBLE	PROBABLE	CONFIRMED
Ovenbird			T[7]	
Common Yellowthroat			T	
Canada Warbler	X			
Scarlet Tanager	X			
Rose-breasted Grosbeak		SH		
Rufous-sided Towhee			T[7]	
Chipping Sparrow	X			
Vesper Sparrow	X[1]			
Savannah Sparrow		SM		
Grasshopper Sparrow				FY[7]
Song Sparrow		SM		
White-throated Sparrow			T	
Dark-eyed Junco	x			
American Tree Sparrow	x[1,6]			
Bobolink			T	
Red-winged Blackbird			T	
Eastern Meadowlark		SH		
Common Grackle		SH		
Brown-headed Cowbird	X			
Northern Oriole			T	
American Goldfinch		SM		
House Sparrow	X[1]			

[1] Records from Cuddy, D.G. (1973a,b). Don Cuddy conducted fieldwork in the park during the period June 13-27, 1973. He recorded nests of Eastern Kingbird, Blue Jay, American Robin and Red-winged Blackbird in his fieldnotes for this period.

[2] Winters, J. pers. comm. 1990. John Winters is Parks Supervisor, Ontario Ministry of Natural Resources Huronia District, Midhurst.

[3] Hood, B. pers. comm. 1990. Bruce and Joyce Hood are biologists who lived on the third line within the park from 1979 to 1987.

[4] Belted Kingfishers used to nest in the park, but have not been observed by the author in recent years, since about 1986 or 1987. Ross Evans observed a pair of Kingfishers and a single bird several years ago (Evans pers. comm.)

[5] Smith, L. pers. comm. 1990. About 25 percent of Leo Smith's 27 nest boxes for Eastern Bluebirds in the park had successful nestings in 1990.

[6] American Tree Sparrow would not occur in the park during the breeding season. The American Tree Sparrow breeds in Ontario "... along the coasts of Hudson and James Bays along the tree-line in low-lying tundra areas ... American Tree Sparrows winter in southern Ontario, arriving in October and November and leaving by the end of April." (Cadman *et al.*, 1987, p. 552)

[7] Records from Evans, R. pers. comm. 1991. Ross Evans conducted field surveys for the Ontario Breeding Bird Atlas at Mono Cliffs Provincial Park, and elsewhere in Square 17NU77, for several years during the period 1982 to 1985.

Two species of birds found in the park are considered to have special status in Central Region, according to Riley and Gould (1989).

Wild Turkey is considered to be Rare in Central Region. Wild Turkey have been sighted in lots 20 and 23, Concession III EHS within the park. This formerly native species is "... now being reintroduced into Central Region by OMNR from wild stock from New Jersey, Vermont, and New York, all originally New York stock." (Riley and Gould 1989, p. 5)

Eastern Bluebird is considered to be Nationally and Provincially Rare by COSEWIC (Risley 1981) and OMNR but the "... population is recovering, especially through the maintenance of nest box trails." (Riley and Gould 1989, p. 10)

APPENDIX E: AMPHIBIANS AND REPTILES OF MONO CLIFFS PROVINCIAL PARK

Nineteen species of amphibians and reptiles have been observed at Mono Cliffs Provincial Park, or within the Area of Natural and Scientific Interest that extends west of the park boundary.

The nomenclature and order of species on the list of herpetofauna follows that of Cook (1984). The full sources of records are given at the end of the list. The acronyms used for sources are those used by the Ontario Herpetofaunal Summary (Oldham and Weller, 1989). The status of species in Central Region is taken from the report, "The Distribution and Status of the Herpetofauna of Central Region" (Plourde *et al.*, 1989). The terms used to describe status and distribution are defined as follows.

Widespread.	Any species that occurs throughout Central Region.
Abundant.	Any species that occurs in high numbers in Central Region.
Common.	Any species that occurs in moderate numbers in Central Region.
Uncommon.	Any species that occurs in low numbers in Central Region, or is seldom observed because of its secretive nature.

Of special significance is a population of the diploid Jefferson Salamander. It represents "... the northernmost known locality for 'pure' *Ambystoma jeffersonianum.*" (Bogart 1991, p. 17). The location of this species is not included in this report, because of its significance and sensitivity. The location of this species is on file at the Southern Region office of the Ministry of Natural Resources, Aurora.

The Yellow-spotted Salamander (*Ambystoma maculata*) has been recorded close to the park (Bogart 1991) and might be found within the boundaries of the park, with further fieldwork.

Also of note are the bones of Fowler's Toad (*Bufo woodhousii fowleri*) reported from a deep fissure cave within the park (Savage pers. comm.). At present, Fowler's Toad is restricted in Ontario to sites along the shoreline of Lake Erie, although this species is widespread throughout the eastern United States (Green 1989).

COMMON NAME	SCIENTIFIC NAME	SOURCES	STATUS IN CENTRAL REGION
Eastern Newt	Notophthalmus viridescens	IHe, JKam, KML, MJO/MDO	Common and Widespread
Jefferson Salamander	Ambystoma jeffersonianum	JPB	Uncommon and Widespread
Eastern Redback Salamander	Plethodon cinereus	JKam,KML	Abundant and Widespread
American Toad	Bufo americanus	JPB, DCu, JKam, KML, MJO/MDO	Abundant and Widespread
Spring Peeper	Hyla crucifer	DCu, JKam, KML, MJO/MDO	Abundant and Widespread
Tetraploid Gray Treefrog	Hyla versicolor	JKam, KML, MJO/MDO	Abundant and Widespread
Striped Chorus Frog	Pseudacris triseriata	KML, MJO/MDO	Abundant and Widespread
Wood Frog	Rana sylvatica	JPB, DCu, KML, MJO/MDO, DAS/APT	Abundant and Widespread
Northern Leopard Frog	Rana pipiens	DCu, JKam, KML, MJO/MDO, DAS/APT	Abundant and Widespread
Pickerel Frog	Rana palustris	JKam, DAS/APT	Uncommon and Widespread
Green Frog	Rana clamitans	JPB, DCu, JKam, KML, MJO/MDO, DAS/APT	Abundant and Widespread
Common Snapping Turtle	Chelydra serpentina	JPB, MJO/MDO	Abundant and Widespread
Painted Turtle	Chrysemys picta	DCu, JKam, KML	Abundant and Widespread
Common Garter Snake	Thamnophis sirtalis	DCu, KML	Abundant and Widespread
Redbelly Snake	Storeria occipitomaculata	DCu, JLR	Uncommon and Widespread
Brown Snake	Storeria dekayi	DCu	Common and Widespread
Smooth Green Snake	Opheodrys vernalis	DCu	Uncommon and Widespread
Ringneck Snake	Diadophis punctatus	DCu	Uncommon and Widespread
Milk Snake	Lampropeltis triangulum	DCu, JKam	Uncommon and Widespread

Sources of Information

JPB	Records from Bogart (1991). Collections of large of Jefferson Salamander were made by W. Cook on 27 June 1990. A juvenile male was collected by W. Cook on 18 July 1990.
DCu	Records from Cuddy (1973). Don Cuddy conducted fieldwork at the park during the period June 13-27, 1973.
IHe	A record of Ian Hendry on 31 May 1988.*
JKam	Records from J. Kamstra on 18 August 1990.
KML	Observations made by K.M. Lindsay during fieldwork for this inventory in 1989, 1990, and 1991. These observations were deposited with the Ontario Herpetofaunal Summary.
MJO/MDO	Records of M.J. Oldham and M. Delisle-Oldham on 19, 20 April, 1987.*
JLR	Observation by J.L. Riley on 1 October 1989.
DAS/APT	Records of D.A. Sutherland and A.P. Thomas on 16 September 1984.*

* These records were kindly provided by Michael Oldham, District Ecologist, Ontario Ministry of Natural Resources, St. Thomas, from the Ontario Herpetofaunal Summary, 1984 to 1988.

APPENDIX F: FISH AND MOLLUSCS OF MONO CLIFFS PROVINCIAL PARK

The 4 species of fish and 12 species of mollusc which have been recorded from the park are listed below. Further study will almost certainly yield more species. Most of these (3 fish species, 9 snail species, 3 clam species) were reported from McCarston's Lake by Kott and MacCrae-Mitchell (1990, p. 33-38). They found Yellow Perch and Largemouth Bass to be the dominant fish species at McCarston's Lake, but their numbers were restricted. "There was evidence of fishing pressure which would contribute to the reduced numbers of fish in such a small lake." The mollusc population of McCarston's Lake is rich in terms of species and numbers.

The coldwater stream habitat along parts of Sheldon Creek within the park is ideal for Brook Trout. Fry and fingerlings of Brook Trout have been observed along one branch of Sheldon Creek all the way upstream to its spring source at a concrete tile casing at UTM 746765 (Hood pers. comm.). Sections of stream which are major reproductive zones are extremely important and highly significant to the fish populations in Sheldon Creek (Imhof pers. comm.). Sticklebacks inhabit pond 10F (Hood pers. comm.)

FISH SPECIES

Ictalurus nebulosus	Brown Bullhead
Micropterus salmoides	Largemouth Bass
Perca flavescens	Yellow Perch
Salvelinus fontinalis	Brook Trout
Gasterosteidae sp.	Stickleback

MOLLUSC SPECIES

Valvata sincera
Amnicola limnosa
Fossaria sp.
Bakerlymnaea dalli
Lymnaea stagnalis
Physa gyrina
Physa integra
Promenetus exacuous
Helisoma trivolvis
Sphaerim rhomboideum
Sphaerim lacustre
Pisidium casertanum

During an assessment of the juvenile salmonid population in Huronia District from 1982 to 1987 (Ewing *et al.* 1988), 14 species of fish were captured at two stations on Sheldon Creek, about 8 km and 13 km downstream of the park, at UTM 30D/4 816807 and 852833. This was the highest number of fish species captured at any of the 11 creeks and rivers sampled, indicating a very diverse and productive system. The species captured in Sheldon Creek were: Rainbow Trout, Brown Trout, Brook Trout, Northern Pike, White Sucker, Northern Redbelly Dace, Brassy Minnow, Common Shiner, Bluntnose Minnow, Blacknose Dace, Longnose Dace, Creek Chub, Johnny Darter and Sculpin. The Rainbow Trout do not travel upstream as far as the park; their travel is blocked by several dams on the stream.